THE

GEOLOGICAL MAGAZINE.

NEW SERIES. DECADE V. VOL. VI.

No. XII.—DECEMBER, 1909.

ORIGINAL ARTICLES.

I.—Eminent Living Geologists.

William Boyd Dawkins, M.A., D.Sc., F.R.S., F.S.A., F.G.S.

(WITH A PORTRAIT, PLATE XXX.)

WILLIAM BOYD DAWKINS, who has recently resigned the Professorship of Geology and Palæontology at the Manchester University, belongs to the comparatively rare, and now dwindling, group of naturalists who have extended their energies across the borderlands of their main subjects, and have become recognized as authorities also in neighbouring territories. If Boyd Dawkins had not been famous in the realm of Geology, he would still have been a prominent figure among anthropologists and archæologists; and if he had not established for himself a name among those whose researches have enriched the data and philosophy of science, he would still have been prominent as a teacher, an organizer, and a public-spirited citizen. Forty years ago, when there were two small collections of natural-history objects in Manchester, the late Professor Huxley nominated young Dawkins as the man with the requisite amount of energy, business capacity, and scientific knowledge to organize a central institution, which now, under the control of the new University of Manchester, is an institution of importance as much to the student who requires reference materials as to the general public. Although the Manchester Museum has now attained dimensions requiring the superintendence by specialists in the three main branches of Natural History, the organization is the direct outcome of its first Curator, through whose influence mainly the money required for buildings has been obtained, and through whose attraction unique collections of materials have been secured.

In 1874 Dawkins was elected to the Chair of Geology in the then young College founded by the munificence of John Owens. Here he soon proved an attractive and inspiring teacher, supplementing the college lectures by practical demonstrations in the field. He imbued a long series of students with enthusiasm for geological work, and among them are many who have subsequently advanced the science by original research. His summer courses of field-excursions were open to others besides his ordinary students, and thus drew to Geology many amateurs who were members of the local societies. Although he resigned the Professorship last year, Dawkins still remains an active member of the controlling Committee of the

Museum, and his popular lectures in the institution attract the public as before.

Although so prominent in the world of science, Dawkins distinguished himself as a student at Oxford in classics, and became diverted to geological interests by the inspiring personality of Professor Phillips at a time when the Natural Sciences were not generally worshipped at our most ancient University. Dawkins, nevertheless, went through the honours' school with distinction, and secured the first Burdett-Coutts scholarship.

As the outcome of an agreement between two College companions and subsequent lifelong friends, the world has been enriched by two well-known works that were intended to supplement one another, namely, *A Short History of the English People*, by John Richard Green, and *Early Man in Britain*, by the subject of this note.

In 1861 Dawkins was appointed to the Geological Survey of Great Britain, and until 1869, when he was secured by the city of Manchester, was occupied in mapping the Wealden and associated formations in Kent and the Thames Valley, when he became interested in the rich mammalian contents of the cave-earths and gravels. For his work on the Pleistocene Mammalia Dawkins was elected in 1867, at the early age of 28, to the Fellowship of the Royal Society. His subsequent work followed this line of research downwards among the mammalian remains of earlier Tertiary times and upwards to the overlapping historical records, paying especial attention to the "central figure of the Pleistocene mammalia", Man. In 1882 he was elected President of the Anthropological Section of the British Association, and six years later President of the Geological Section, while in 1889 his services to Geology were recognized by the Geological Society of London with the Lyell Medal. He has also been elected an Honorary Member of societies like the Berlin Anthropological, the Academy of Philadelphia, the Natural History Society of Boston, and the Geological Society of Belgium. On retirement from the Chair at Manchester, Dawkins was elected an Honorary Professor in the University, and has since received the Honorary Degree of D.Sc.

Dawkins' papers on Tertiary Mammalia are marked not only by detailed and accurate descriptions of forms, but by a clear appreciation of the ways in which the materials described bear on palæontological science. His descriptive work cleared up the confusion into which the British Pleistocene rhinoceroses had previously fallen, he showed that the lion and hyæna found in the cave deposits belonged to living species, and he added greatly to our record of Pleistocene Cervidæ and Bovidæ. His work in conjunction with Sanford on the lion from the materials preserved in the Taunton Museum is still one of the most detailed osteological monographs of any mammal, recent or fossil. In clearing up the confusion then existing regarding the Miocene and Pliocene deer, Dawkins pointed out the gradual increase in the complexity of the antlers in phylogeny, and thus indicated the resemblance between this development and the changes which take place during the life of a modern deer.

Dawkins' interest in the deeper problems of palæontology is shown especially by his paper on the distribution of the mammoth in space

and time, and by the discussions prefixed to many of his descriptive papers on Pleistocene mammals. His paper on the classification of the Tertiary Period by means of the mammalian fossils demonstrated the principle that successions of stratified deposits may be divided on the evidence obtained by a study of the gradual evolution of structure displayed by some marked group which is *en plein évolution*. The principles established in this paper were published in a more expanded form in *Early Man in Britain*.

Dawkins was the first to point out the evidence indicating the existence of two Pleistocene cave faunæ—a lower with *E. antiquus*, *Hippopotamus*, and *Rhinoceros hemitoechus*, and an upper with *E. primigenius* and *R. tichorhinus*, the two occurring sometimes in the same cave. He showed, also, that the fauna of the Forest-bed passes on to the former of these two periods, and so established for the Pleistocene records in Britain three separated divisions. He pointed out the composite character of the British Pleistocene mammals, and indicated the elements derived from the 'Arctic', 'Southern', and 'Temperate' or 'Eastern' groups, drawing on the known facts of migration to explain the apparent commingling of species following changes of climate. The long-continued researches on cave faunæ were fittingly crowned by the discovery at Doveholes in 1903 of cave mammals of Pliocene age.

The bearing of the Pleistocene data on anthropological problems is not the least important of the work done by Dawkins. His suggestions that the Eskimos are the descendants of the cave men, and that the Iberians are descended from the Neolithic people, have assisted the complicated problems of the European anthropologist, while the data gathered regarding prehistoric trade-routes and the relationship of the Mykenæan culture to that of Northern Europe during the Bronze Age are of extreme interest to the archæologist. *Early Man in Britain* became the foundation stone of researches which have since developed along many lines of thought, and this remarkable work has consequently become, not merely a popular presentation of a wide group of related subjects of human interest, but a classic to the archæologist and anthropologist.

LIST OF PUBLICATIONS BY PROFESSOR W. BOYD DAWKINS.

(Compiled by D. M. S. Watson.)

1862. "On a Hyæna Den at Wookey Hole, near Wells": Quart. Journ. Geol. Soc., vol. xviii, pp. 115–25.

1863. "On the Molar Series of *Rhinoceros tichorhinus*": Nat. Hist. Rev., vol. iii, pp. 525–38.

1864. "On the Rhætic and White Lias of Western and Central Somerset: and on the Discovery of a new Mammal in the Gray Marlstones beneath the Bone Bed": Quart. Journ. Geol. Soc., vol. xx, pp. 396–412.

1865. "On the Dentition of *Hyæna spelæa* and its Varieties, with notes on the Recent Species": Nat. Hist. Rev., N.S., vol. v, pp. 80–96.

"On the Dentition of *Rhinoceros megarhinus*, I. de Christol": ibid., p. 399, figs. 1–15.

"On the Mammalian Remains found by E. Wood, Esq., near Richmond, Yorkshire": Quart. Journ. Geol. Soc., vol. xxi, pp. 493–5.

1866. "On the Fossil British Oxen."—Part I: *Bos Urus*, Cæsar: ibid., vol. xxii, pp. 391–401.

"On the Dentition of *Rhinoceros leptorhinus*, Owen": Proc. Roy. Soc. vol. xv, p. 106.

1867. "On the Age of the Lower Brick Earths of the Thames Valley": Quart. Journ. Geol. Soc., vol. xxiii, pp. 91–109.
"On the British Fossil Oxen."—Part II: *Bos longifrons*, Owen: ibid., pp. 176–84.
"On the Dentition of *Rhinoceros leptorhinus*, Owen": ibid., pp. 213–27, pl. x.
"*Ovibos moschatus*": Proc. Roy. Soc., vol. xv, p. 516.

1868. "On the Dentition of *Rhinoceros Etruscus*, Falc.": Quart. Journ. Geol. Soc., vol. xxiv, pp. 207–17, pls. vii and viii.
"On a New Species of Fossil Deer from Clacton": ibid., pp. 511–16, pls. xvii and xviii.
"On a New Species of Deer from the Norwich Crag": ibid., pp. 516–18, pl. xviii.

1869. "On the Distribution of the British Post-Glacial Mammals": ibid., vol. xxv, pp. 192–217.

1870. "The Denbighshire Caves": Trans. Manch. Geol. Soc., vol. ix, pp. 31–7.
"On the Discovery of Flint and Chert under a Submerged Forest in West Somerset": Journ. Eth. Soc., n.s., vol. ii, pp. 141–5.
"On the Discovery of Platycnemic Men in Denbighshire": ibid., pp. 440–68, figs. and pl. xxxi.

1871. "On the Formation of Caves around Ingleborough": Trans. Manch. Geol. Soc., vol. x, pp. 106–12, figs.
"Report on the Results obtained by the Settle Cave Exploration Committee out of Victoria Cave in 1870": Journ. Anthrop. Inst., vol. i, pp. 60–70, figs. and pls. i and ii.
"On the Discovery of the Glutton, *Gulo luscus*, in Britain": Quart. Journ. Geol. Soc., vol. xxvii, pp. 406–10.

1872. "The Climate of the Pleistocene Age": Trans. Manch. Geol. Soc., vol. xi, pp. 45–52.
"On the Cervidæ of the Forest-bed of Norfolk and Suffolk": Quart. Journ. Geol. Soc., vol. xxviii, pp. 405–10.
"The Classification of the Pleistocene Strata of Britain and the Continent by means of the Mammalia": ibid., pp. 410–46.

1874. *Cave Hunting: Researches on the evidence of Caves respecting the Early Inhabitants of Europe;* London, Macmillan.
"The Limits of our Knowledge of the Earth": Owens College Essays, pp. 129–60.

1875. "On the Stone Mining Tools from Alderley Edge, Cheshire": Journ. Anthrop. Inst., vol. v, pp. 2–5, pl. i.
"The Mammalia found at Windy Knoll": Quart. Journ. Geol. Soc., vol. xxxi, pp. 246–58.

1876. "On the Mammalia and Traces of Man found in the Robin Hood Cave": ibid., vol. xxxii, pp. 245–58.

1877. "On the Mammal Fauna of the Caves of Cresswell Crags": ibid., vol. xxxiii, pp. 589–611.
"On the Evidence afforded by the Caves of Great Britain as to the Antiquity of Man": Journ. Anthrop. Inst., vol. vii, pp. 151–62 and 174–85.
"The Exploration of the Ossiferous Deposits at Windy Knoll, Castleton, Derbyshire": Quart. Journ. Geol. Soc., vol. xxxiii, pp. 724–9.

1866–78. A Monograph of the Pleistocene Mammalia of Britain: *Felis, Cervus, Ovibos:* Palæontographical Society.

1878. "A Contribution to the History of the Deer of the European Miocene and Pliocene Strata": Quart. Journ. Geol. Soc., vol. xxxiv, pp. 402–19, figs.

1879. "On the Range of the Mammoth in Space and Time": ibid., vol. xxxv, pp. 138–46.
"Further Discoveries in the Cresswell Crags": ibid., pp. 724–34.

1880. "The Classification of the Tertiary Period by means of the Mammalia": ibid., vol. xxxvi, pp. 379–403.
Early Man in Britain and his place in the Tertiary Period; London, Macmillan.

1883. "On the alleged existence of *Ovibos moschatus* in the Forest-bed and its Range in Space and Time": Quart. Journ. Geol. Soc., vol. xxxix, pp. 575–81.

1885. Note on Dr. C. I. Forsyth-Major's paper "On the Mammalian Fauna of the Val d'Arno": Quart. Journ. Geol. Soc., vol. xli, p. 8.
"On a Skull of *Ovibos moschatus* from the Sea Bottom": ibid., pp. 242–4.

1888. "On *Ailurus anglicus*, a new Carnivore from the Red Crag": ibid., vol. xliv, pp. 228–30, pl. x.
"On the Geography of Britain in the Carboniferous Period": Trans. Manch. Geol. Soc., vol. xix, pp. 37–47.

1889. "The Place of the Welsh in the History of Britain": reprint from the *Manchester Examiner*.

1890. "On the Clay Slates and Phyllites of the South of the Isle of Man; and a Section of the Foxdale Mine, Isle of Man": Trans. Manch. Geol. Soc., vol. xx, pp. 53–7.
"The Discovery of Coal Measures near Dover": ibid., pp. 502–12, sections.

1893. Report on Supplemental Supply from Wells in the London Area: Statement in Evidence before the Royal Commission on the Metropolitan Water Supply, Appendix C 44, p. 419.

1894. "On the Relation of the Palæolithic to the Neolithic Period": Journ. Anthrop. Inst., vol. xxiii, pp. 242–51.
"The Coal-fields of New South Wales": Trans. Manch. Geol. Soc., vol. xxii, pp. 160–9, sketch-map and sections.
"On the South-Eastern Coal-field at Dover": ibid., pp. 488–505.
"On the Geology of the Isle of Man," Part I: ibid., pp. 590–606, sections.

1895. "The Geology of the Isle of Man," Part II: ibid., vol. xxiii, pp. 147–58.
"Sanitary Progress in Prehistoric Times": Sanitary Conference at Manchester.

1897. "The Present Phase of Prehistoric Archæology": Journ. Arch. Inst.

1898. "On the History of the Discovery of the South-Eastern Coal-field": Trans. Manch. Geol. Soc., vol. xxv, pp. 155–60.

1899. "The Chartley White Cattle": Trans. North Staffs. Field Club.
"The Place of a University in the History of Wales": an Address delivered to the University of Wales at Bangor.
"On the South-Eastern Coal-field": Geol. Mag., n.s., Dec. IV, Vol. VI, pp. 501–5.

1900. "Early Man in Hampshire": Victoria County History.
"The Exploration of Hod Hill, near Blanford, in 1897": Journ. Arch. Inst.

1901. "Skulls from Cave Burials": Annual Report of the British School at Athens, No. vii, pp. 150–5, pl. vi.
"The Exploration of Prehistoric Sepulchral Remains of the Bronze Age at Bleasdale by S. Jackson": Trans. Lanc. and Ches. Antiq. Soc.
"The Cairn and Sepulchral Cave of Gop, near Prestatyn": Journ. Arch. Inst.

1902. "Remains of Animals found in the Dictæan Cave in 1901": *Man*, p. 114.
"The Red Sandstone Rocks of Peel (Isle of Man)": Quart. Journ. Geol. Soc., vol. lviii, pp. 632–46, map, pl. xxxiii, and figs.
"On Bigbury Camp and the Pilgrim's Way": Journ. Arch. Inst.

1903. "The Buried Coal-fields of Southern England": Statement in Evidence before the Royal Commission on Coal Supply, Final Report, pt. x, pp. 26–35, pls. i–vi.
Review of "A Guide to the Antiquities of the Stone Age in the Department of British and Mediæval Antiquities", by C. H. Read, F.S.A.: *Man*, vol. iii, p. 31.
"On the Discovery of an Ossiferous Cavern of Pliocene Age at Doveholes, Buxton (Derbyshire)": Quart. Journ. Geol. Soc., vol. lix, pp. 105–29, pls. viii–xii.

1904. "A Section of the Glacial Deposits met with in the construction of the New Dock at Salford": Trans. Manch. Geol. Soc., vol. xxix, pp. 34–6.
"The Permian and Carboniferous Rocks in a Section in High Street, Chorlton-on-Medlock, Manchester": ibid., pp. 37–40.
"On the Discovery of *Elephas antiquus* at Blackpool": Manch. Mem., vol. xlviii, No. xviii, pp. 1–4.

1905. "On the Pre-Roman Roads of Northern and Eastern Yorkshire": Journ. Arch. Inst.
"Note on the Discovery of the South-Eastern Coal-field": Trans. Manch. Geol. Soc., vol. xxix, pp. 134–7.
1906. "Early Man in Somerset": Victoria County History.
1907. "The Discovery of the South-Eastern Coal-field": Journ. Soc. Arts, vol. lv, pp. 150–8, figs.

II.—On a Palæolithic Implement found *in situ* in the Cambridgeshire Gravels.

By J. E. Marr, Sc.D., F.R.S.

(PLATE XXXI.)

DURING the Long Vacation of 1909, I was fortunate enough, when examining some gravel-pits in the company of Messrs. Rastall, Romanes, and Gandy, of Christ's College, to discover a Palæolithic implement, *in situ*, near Hildersham, Cambridgeshire.

As the recorded examples of implements of this age in the county are extremely few, and as the specimen which I discovered was extracted from a deposit the relationship of which to the other Pleistocene gravels is uncertain, a deposit, moreover, which is at a considerable height above the river in its vicinity, I am induced to record briefly the conditions of occurrence of the implement.

Notices of previous discoveries, with references to the original records, will be found in Mr. F. R. C. Reed's *Handbook to the Geology of Cambridgeshire* (1897), pp. 237–9, and in an article by Dr. Duckworth in the *Handbook to the Natural History of Cambridgeshire* (1904), p. 248. One of these discoveries (made by Mrs. Hughes near Upper Hare Park) must be noticed more fully. In a paper printed in the *Journal of the British Archæological Association* for 1899, Professor Hughes writes: "I know of only one authenticated case of a Palæolithic implement found *in situ*. That was dug out of the gravel on the top of Allington Hill by Mrs. Hughes. The height of this gravel above sea-level is about 150 feet." The discovery of the specimen was first recorded in *Nature* for 1884 (vol. xxx, p. 632), and it is figured in the *Archæological Journal* for 1897 (pl. iv, fig. B 9, facing p. 372).

As Messrs. Rastall and Romanes are at present engaged in the study of the Cambridgeshire gravels, I do not propose to say more concerning them than is sufficient for my purpose.

In the Geological Survey Memoir of the neighbourhood of Cambridge will be found an account of the distribution of the various gravels; those with which we are concerned are spoken of therein as "Marine Gravels and Loam" and "Gravels of the Ancient River System" respectively; the former are frequently termed the "Plateau Gravels", which name will be subsequently used in this paper.

On the Geological Survey Map the plateau gravels (coloured pink) are represented as extending in patches from the Gog Magog Hills on the north-west to Barrington Hill on the south-east, lying in the intervening tract a little to the north-east of the villages of Babraham, Little Abington, and Hildersham. The later gravels (coloured brown) extend on either side of the course of the present stream, and at no

great height above it, in a continuous band, parallel with and lying to the south-west of the stretch of plateau gravels.

The plateau gravels at Barrington Hill are at a height of over 350 feet above sea-level, those on the Gog Magog Hills about 225 feet above the same level. In the Survey Memoir they are described as occurring at a lower level to the north-west of Barrington Hill, falling to their lowest point east of Babraham, and gradually rising again to the top of the Gog Magog Hills. It is in the tract where the gravels are at a lower level that the implement was found, and the fall of level between the gravels capping Barrington Hill and those which yielded the implement occurs in a comparatively short horizontal distance.

There is more than one view as to the origin of the plateau gravels, but whichever we accept it seems improbable that these gravels should contain implements, and I think that at any rate part of the gravel patch north-east of Hildersham and part of the spread of similar gravels north-east of Little Abington do not belong to the plateau gravels but consist of gravels of the Ancient River System. They are found flanking the ridge some distance below its summit, whereas the plateau gravels on Barrington Hill and the Gog Magog Hills cap the hill-summits. I believe, therefore, that further work will prove that two distinct gravels have been mapped as plateau gravels, and that the implement-bearing gravels will be found to have been deposited against the older plateau gravels.

Before visiting the pit in which the implement was found we examined two pits close to "Sand Pit Plantation" (see 6-inch map), half a mile north-north-east of Lay Rectory Farm, Little Abington, and situated about the level of the 200-foot contour-line. One of these pits contained chalky drift with many foreign boulders; the other, only a few yards away, showed coarse angular gravel and beds of angular flints with finely laminated red-brown and yellow-grey sand. The gravel here preponderated over the sand. The relationship between the deposits in the two pits was unfortunately not seen. The beds in the latter pit strongly resemble those of other exposures of river gravels.

The implement which forms the subject of this communication was found in a pit on the west side of Furze Hill, north-east of Hildersham, about 200 yards north-east of the road flanking the south-west side of the hill. This pit is also situated about the level of the 200-foot contour-line. The section seen in it was as follows:—

6. About 10 feet of angular flint gravel with seams of bedded sand.
5. About 4 feet of bedded brownish-red sand with scattered flints.
4. 6 inches of sand with small flints.
3. 2 feet of bedded brown sand.
2. 6 inches of sand with small flints. (The implement was close to the top of this bed.)
1. 3 feet seen of bedded brown sand, the beds below this being concealed by talus.

There is little doubt that these sands and gravels were once continuous with the similar deposits in the gravel-pit north-north-east of Lay Rectory Farm. The two deposits are quite similar in every respect save that in the Hildersham pit the proportion of sand to gravel is somewhat greater than in the farm pit.

The face of the pit was extremely steep, and the implement could not have fallen from above and rested where it lay, namely, on a sloping ledge about 4 inches wide, with the face of the gravel above and below nearly vertical. The greater part of one face of the implement was exposed on the ledge, and on removing the flint its 'mould' remained in semi-coherent sand. Some of this sand still remains firmly cemented in one or two little depressions of the implement. There is no doubt, therefore, as to its occurrence *in situ*.

The implement itself is well fashioned, of ovoid shape, formed of brown flint, and but little worn. The point has apparently been broken off during manufacture or when in use, for the patina on the fracture is similar to that over the dressed surface. It measures $3\frac{7}{10}$ inches in length by $2\frac{3}{4}$ in breadth at the widest part. I have deposited it in the Sedgwick Museum.

Its occurrence about 100 feet above the present river level at Hildersham is of interest, but is not contrary to what might reasonably be expected. Some 5 miles in a northerly direction lie the elephant-bearing gravels near Lark's Hall, at a height about that of the gravels we are considering. They there occur in a valley, and are traceable from thence almost continuously (save where cut through by the modern Cam near Cambridge), along the ridge of Wilbraham and Quy Church past the Observatory and away northward into the Fenland. Were it not for subsequent denudation by the Granta, the Hildersham gravels might be traceable in the same way past Babraham and Shelford, and so northward to join the gravels mentioned above, near Cambridge.

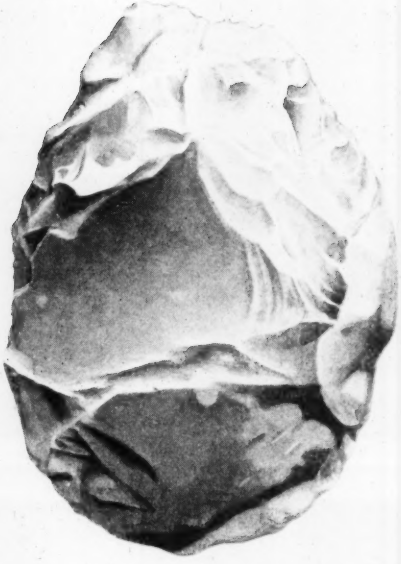
Although the implement found by Mrs. Hughes near Upper Hare Park was associated with gravels which are not inserted on the Geological Survey Map, and the views of the surveyors as to their age are therefore unrecorded, their position would suggest that they might belong to the period of formation of the Quy Church and Wilbraham gravel. It is desirable that further search should be made in these high-level gravels in various parts of the county, as was indeed long ago suggested by the late Sir John Evans (see Dr. Bonney's *Cambridgeshire Geology*, p. 56).

The Cam has eroded its valley at Cambridge to a depth of nearly 50 feet below the level of the Observatory gravels: there is, therefore, little cause for surprise if erosion has taken place to about double that amount at Hildersham. In fact (even allowing for a larger volume of water), a grade steeper than that of the present Cam, which falls about 80 feet between Little Abington and Cambridge, is probably necessary to account for the transport of the coarse flint pebbles which largely compose many beds of the Observatory gravel. The fall from 200 feet to 60 feet (which is the difference in height between the Palæolithic gravels of Hildersham and the Observatory gravels) in a distance of about 12 miles measured in a straight line, or, allowing for sinuosities, say a fall of 10 feet per mile, does not appear too much to allow for the transport of these flints.

The mere existence of an implement of the type found in the Hildersham gravel renders it unlikely that the gravel belongs to the 'plateau series', and points to its assignment to one of the older river

3

2



1

R. H. Rastall, M.A., Photo.

Palæolithic Implement : Hildersham, Cambs.

gravels. In suggesting that it belongs to the period of the Wilbraham–Quy gravels I do not desire to hint at their strict contemporaneity. I would only submit that if separable from the plateau gravels the evidence is in favour of its being grouped with the deposits referred to by the Geological Surveyors rather under the title "Gravels of the Ancient River System" than to those which they describe under the heading of "Gravels of the Present River System."

EXPLANATION OF PLATE XXXI.

Palæolithic Implement from near Hildersham, Cambridgeshire. The view of the face, Fig. 1, is about $\frac{3}{4}$ nat. size; that of the edge, Fig. 2, about $\frac{1}{2}$ nat. size; Fig. 3, ideal section.

III.—Post-Glacial Time and Ancient Egypt.

By Edward Greenly, F.G.S.

PERPLEXING as are all problems connected with geological time, there has naturally appeared much more hope of determining the length of the period that has elapsed since the close of the great Glacial episode in the Northern Hemisphere, the period in which, indeed, we may be said to live, seeing that many processes that can be observed in action may be supposed to have gone on without interruption from the disappearance of the ice to the present day. It has proved, however, scarcely less difficult than the other problems of geological chronology. Many methods have been applied, and the results reached have been hardly less varied than the methods.

In the last few years a group of investigators, applying anew the method of Bakewell, Lyell, and others, the measurement, that is, of the rate of recession of Niagara and other waterfalls, have arrived at estimates that are surprisingly short, some of them even restricting Post-Glacial time to not more than about 6000 years.

Has it been perceived, however, that such estimates as these must of necessity bring the matter into touch with another series of chronological measurements, derived from totally distinct data, and by a quite independent group of investigators?

At a time when all the mountain-ranges of the northern shores of the Mediterranean basin were heavily glaciated, when the Alps sent out gigantic glaciers into the Plain of Lombardy, it is certain that the whole Mediterranean region must have been, in varying degrees, affected by such conditions. Not for a long time after they had passed away—after, that is, what we call the "close of the Glacial Period", when the ice had disappeared from Northern and Central Europe—can the countries along the southern shores of the Mediterranean have settled down to climatic conditions approximately like those that obtain in them to-day.

Now, the monuments of the First Dynasty in Egypt carry us back considerably more than 4000 years before the Christian era—that is to say, more than 6000 years before the present time—and these monuments are those of a thoroughly settled and civilized people. But behind this time lies the period of the prehistoric culture, which, in the opinion of the best authorities such as Professor Flinders Petrie,

must have extended not less than some 2000 or 3000 years further back still — that is, to some 8000 or 9000 years from now. And Professor Flinders Petrie informs me that neither in the remains of the historic nor of the prehistoric period can he find any evidence of a climate that was appreciably different from that of Egypt at the present time. If, then, the estimates of Post-Glacial time that are under consideration can be accepted, we must suppose that large, civilized, agricultural populations lived and moved and had their being, built the monuments and left the legible inscriptions that have come down to us to-day, utterly unaffected, during a period of some 3000 or 4000 years, by the gigantic changes of climate that were in progress no further away than the northern shores of the Mediterranean!

During the past thirty or forty years we have been told so many times that this or that consideration, generally a physical one, imposed an absolute limit on some piece of geological chronology, that geologists may well pause before insisting that archæology can impose a limit of another kind. The history of speculation upon geological time may well serve to sober the boldest of calculators. Nevertheless, there does seem reason to think that the records so wonderfully brought to light from Ancient Egypt may aid us in the solution of a vexed question in geology, even as they are now doing with regard to vexed questions in other subjects of research.

IV.—On some Dry Chalk Valley Features.

By R. H. Chandler.

THE existence of a 'wind gap' or 'pass' at the head of a dry dip valley clearly points to the former extension of that valley beyond the present escarpment; and the depth of the gap is a measure of the size of the valley before being beheaded by the recession of the escarpment. Thus the gap at Merstham is about 300 feet deep, and the valley would probably have continued south some miles on to the Wealden uplands; the floor of this valley falls regularly north, and presents all the features due to a stream flowing in that direction previous to the formation of the Gault strike valley. As an instance of a less developed beheaded valley, the Maplescombe valley, which joins the Darent valley on the right bank at Farningham, may be instanced. The Maplescombe valley has a 'wind gap' of possibly 100 feet deep, and so its former southward extension would not have continued into the Wealden area as far as the Merstham valley; moreover, the floor does not slope regularly to the Darent, but is steepest at the head, the distance between each contour-line increasing as one descends the valley, viz.—

600 to 500 in 1700 feet, or fall of 1 in 17.
500 to 400 in 3000 feet, or fall of 1 in 30.
400 to 300 in 5300 feet, or fall of 1 in 53.
300 to 200 in 7200 feet, or fall of 1 in 72.

The present valley floor, particularly the upper part, is evidently not the one down which a stream from the Weald would have flowed, for at the above noted rate of increased slope the valley would 'run

out' (or become extinct) at a very few hundred yards south of the present Chalk escarpment, and this short length is not compatible with the excavation of a valley 100 feet deep, such as the present wind gap.

A feature that appears to have been overlooked, by the various geologists who have written about this subject, is that the beheading of 'dry' Chalk dip valleys, by the formation of strike Gault valleys behind them, would cause a lowering of the saturation level of the Chalk; and as the Gault would probably be rapidly excavated, the lowering of the saturation line of the Chalk would be proportionately rapid.[1]

Now the early dip stream initiating the 'dry' valley system would doubtless flow at about the level and the gradient of the line of saturation in the Chalk at that time, so that when the valley was beheaded, and the saturation level lowered (owing to the Gault Stream), the springs in the 'dry' valley would be thrown out at successively lower levels, and by the upper parts of the valley being dry earlier than the lower, and the well-known action of springs in cutting backward, thus forming a steep bank behind, it is here proposed that the present progressive increased steepness of the valley floor upward may be explained.

The characteristic deposits of gravel, consisting of angular and little-worn flints, few Tertiary pebbles, and occasional pieces of Lower Greensand chert and ironstone, in a clayey matrix, found on the floors of these valleys, seem to show that very little of it was formed by ordinary river action, but that the deposit was due to the dissolution of the chalk from around the flints by a stream of water without much transporting power, such as might take place by a flow parallel to and below the valley floor,[2] and each such flow by lowering the chalk and leaving the unworn flints would deepen the deposit of 'dry valley gravel' found in these situations; added to which the occasional existence of a 'bourne' would account for the presence of bedding rarely shown by this gravel.

Anything more unlike ordinary river gravel than this 'dry' valley gravel it is difficult to imagine, and as bournes do occasionally break out it seems reasonable to suppose that when the bourne is not visible at the surface it is flowing some distance underneath, dissolving the chalk and leaving the insoluble constituents. The Lower Greensand and other water-worn material are the relics of the early stream (or they may be from the immediate 'plateau'), and the clayey part of the drift is the insoluble residue of the chalk and the rainwash from the slopes on either side.

Features due to the early river action (as distinguished from the later or bourne features) may be found in the general configuration of the valley, and more especially in the upper (and older) parts of the sides where steep banks occur alternately on either hand, due to the river cutting into its banks on the outer part of its curves.

[1] The saturation line consisting of two curves meeting at some distance in from the escarpment on the dip side, a gentle slope down the dip, and a steeper one falling towards the escarpment. It is the lowering of the point of intersection of these two curves, and the movement of this point in the direction of the dip, that is here spoken of as the lowering of the saturation level in the Chalk.

[2] *Vide* Prestwich, *Water-bearing Strata of London*, 1851, p. 132.

V.—On some Middle and Upper-Lias Sections near Batcombe, Somerset.

By L. Richardson, F.R.S.E., F.G.S.

In 1906 I described, in this Magazine,[1] a section at Maes Down, between Evercreech and Doulting, in which the Marlstone of the Middle Lias and certain Upper-Lias beds were exposed. The main interest of this section lay in the fact that the beds exposed occurred in a tract that had been mapped as Inferior Oolite resting upon Midford Sands, and these in turn directly upon the Lower Lias without the intervention of any Middle Lias. Naturally it was wondered what had become of the Middle Lias. This Maes-Down section therefore proved the presence of typical Marlstone and certain basal Upper-Lias beds (consisting of thin alternating layers of clay and limestone), while on the higher ground, above the level of the quarry, are unmistakable signs of Midford Sands.

Although I have inspected the hill-slopes between Maes Down and Chelynch (on the slopes of the Mendips), I have failed to find any exposure that throws light upon the probable northerly extension of the Middle Lias, or the relations of that stage to the Lower Lias.

The Midford Sands, however, are very fairly exposed at the top of the bank on the south side of the road, close to the south-eastern corner of the Doulting Sheep Sleight; and ammonites indicative of *striatuli* hemera have been procured from a limestone-bed in the bank by the side of the main-road, where it climbs the hill between Shepton Mallet and Doulting.[2]

In the hills between Maes Down and Bruton it is probable that the sequence is everywhere in ascending order: (1) Marlstone; (2) Upper-Lias clays and limestones; and (3) Upper-Lias Sands. The Marlstone and basal Upper-Lias clays and limestones are excellently displayed in the quarry at Small Down, and in that in Westcombe village, near Batcombe; while the Sands are deeply-incised by the lane that descends Lamyat Beacon in the direction of Week Champflower.

Sir Henry de la Beche assigned a thickness of 21 feet to the Marlstone at Scale Hill, near Batcombe, and estimated the thickness of the Upper-Lias deposits at 66 feet.[3] Commenting upon Sir H. de la Beche's estimates, Mr. H. B. Woodward, F.R.S., writes that the "Marlstone, although present, does not appear to comprise a mass of strata 21 feet thick, as stated by him".[4] It may be too liberal an estimate (if it does not include the underlying "sandy beds" of the Middle Lias), but still the Marlstone is very well-developed in this neighbourhood, as the two sections I am about to record demonstrate.

The first section to notice is that on the western slope of the camp-crowned hill, about half-a-mile to the south-east of Chesterblade. Locally, it is called the "Small-Down Quarry". It is a little difficult to indicate on the one-inch Geological Survey Map, sheet xix,

[1] Geol. Mag., Dec. V, Vol. III, 1906, pp. 368–9.

[2] Quart. Journ. Geol. Soc., 1907, vol. lxiii, p. 391; Geol. Mag., 1908, p. 510 (footnote).

[3] Mem. Geol. Surv., 1846, vol. i, p. 280 (footnote).

[4] Mem. Geol. Surv., 1893, vol. iii, p. 207: "The Jurassic Rocks of Britain: The Lias of England and Wales (Yorkshire excepted)."

its precise position, because the topographical information is none too detailed, but it certainly comes within the area mapped as Upper Lias, if not actually on the Inferior Oolite. I have not investigated the hill above Small Down with a view to mapping the distribution of the various beds, but it appears as though the deposits mapped as Midford Sands are really the "sandy beds" of the Middle Lias; the Inferior Oolite, the Marlstone; the Lower Fuller's Earth, the Upper Lias (clays and limestones and sands); and the Fuller's-Earth Rock, Inferior Oolite. The beds on the top of the hill have a north-north-easterly inclination, dipping down towards the great fault that has so conspicuously depressed the beds to the north of it, and whose westerly continuation is the probable cause of the Marlstone of Maes Down being on about the same level as the Inferior Oolite to the north.

SMALL-DOWN QUARRY.

				Thickness in ft.	Thickness in in.	
Toarcian.	*Lilli*	1	Limestone, rubbly, earthy, brownish, with dark-brown iron-specks: seen	1	0	*Hildoceras semipolitum*, S. Buckman, *Rhynchonella* cf. *Moorei*, Davidson, *Belemnites* spp.
		2	Parting	0	0½	
	Bifrontis	3*a*	Limestone, bluish-grey and brownish, with dark-brown ferruginous granules	1	10	*Hildoceras bifrons*, (Young & Bird), *Nautilus* sp., *Belemnites* spp., *Astarte* sp., *Hamites velatus*, Goldfuss.
		3*b*	Parting	0	0½	
	Falciferi	3*c*	Limestone, similar to 3*a*	0	8	*Harpoceras elegans* (J. Sowerby), *Dactylioceras* cf. *vernis* (Simpson), *Belemnites*.
		4	Clay, dark-purplish, with rolled fragments of ammonites common at the top: 3 to 7 inches	0	5	*Harpoceras* cf. *exaratum* (Y. & B.), *H.* cf. *falciferum* (J. Sow.), *Rhynchonella jurensis* (Quenstedt).
	?*Falciferi*	5	Limestone, brownish-grey, somewhat sparsely iron-shot, in lenticular nodule-shaped masses, and often in two layers fitting into the irregularities of the Marlstone	0	6	*Dactylioceras gracile*? (Simpson)
		6	Clay: 0 to 1 inch	0	1	
Pliensbachian		7	Marl-stone: seen	5	0	*Belemnites*, very common in the top layer: usual fossils.

A comparison of this section with that at Maes Down will show the similarity of the deposits; the dark-purplish clay-bed being an easily-identifiable horizon. At Small Down there is a higher bed exposed than any at Maes Down, and the ammonite *Hildoceras semipolitum*, S. Buckman, shows that it is of *Lilli* hemera.

The quarry at Westcombe displays a long face of Marlstone capped with a few feet of Upper Lias. Probably it was from here that the

rock-specimen of Marlstone which is preserved in the Jermyn Street Museum was obtained.[1]

WESTCOMBE QUARRY, NEAR BATCOMBE.

				Thickness in ft.	Thickness in in.	
Toarcian.	*Bifrontis* and ?part *falciferi*	3	Limestone, much disturbed, grey-brown, with yellowish iron-granules, full of specimens of *Hildoceras hildense* (Y. & B.), shell-fragments and belemnites: seen	1	3	*Pseudolioceras elegantulum* (Y. & B.), *Hildoceras hildense* (Y. & B.), *Dactylioceras holandrei* (d'Orb.), *Peronoceras desplacei* (d'Orb.), *Cincta Lycetti* (Davidson), *Rhynchonella jurensis* (Quenstedt), *Terebratula* sp. (probably new), *Syncyclonema* sp.
	Falciferi	4	Clay, bluish-grey: 4 to 6 inches	0	5	
		5	Limestone, greyish-blue	0	3	*Harpoceras* sp.
		6	Clay, bluish-grey: 0 to 1 inch	0	0½	
Pliensbachian		7	Marlstone, top layer full of specimens of *Terebratula punctata*, Sow., and belemnites: seen	5	0	*Amaltheus* (fragment), *Paltopleuroceras* sp., *Rhynchonella amalthei* (Quenstedt), *Rh. tetrahedra* (Sow.), *Terebratula punctata*, Sow., *Ornithella indentata* (Sow.), *Ostrea sportella* (E. Dumortier), *Protocardia truncata* (Sow.), *Syncyclonema* sp., *Pseudopecten æquivalvis* (Sow.), *Chlamys Humberti* (Dum.), *Pleuromya Jauberti*, Dum.,[2] *Pleatula pectinoides* (Lamarck),[3] *Cryptænia expansa*, Sow.

Summary.—In the neighbourhood of Batcombe the Marlstone of the Middle Lias is typically developed, and is succeeded by thin alternating layers of clay and limestone, which are in turn followed by pale-yellow fine-grained sands—near Bruton, of considerable thickness.

VI.—On the Type-specimen of *Pseudomelania vittata* (Phillips).

By J. Wilfrid Jackson, F.G.S., Assistant Keeper of the Manchester Museum.

I HAVE recently had the good fortune to come across the lost type-specimen of Phillips' *Melania vittata* in the course of going through the contents of one of the reserve cabinets in the Manchester

[1] Mem. Geol. Surv., 1893, vol. iii, p. 207: "The Jurassic Rocks of Britain: The Lias of England and Wales (Yorkshire excepted)."

[2] *Études Pal. sur les Dépôts Jurassiques du Bassin du Rhone*, 1869, 3ième pt., pl. xxix, fig. 8.

[3] Ibid., pl. xl, fig. 7.

Museum. The specimen was along with a number of others which formed part of the late Professor Williamson's collection, and my attention was drawn to it being the type by seeing a label attached bearing the following inscription: "This specimen is figured in Phillips' *Geol. York.*, pl. 7, fig. 15." A comparison with Phillips' figure confirmed this fact.

On referring to the second edition (1835) of the above work, pp. 116 and 181, it will be seen that the species was founded on a specimen from the Cornbrash of Scarborough, in Mr. Williamson's collection, i.e. John Williamson, the Professor's father. The species, Mr. B. B. Woodward tells me, is also figured in the first edition of the *Geology of Yorkshire* (1829), on pl. 7, fig. 15, and is given among the Cornbrash fossils on p. 145, and in the list of plates, p. 189, but is nowhere actually described.

Phillips, in his explanation of the plates (2nd ed., p. 177) says the specimens in the Williamson collection figured by him in his work have since been transferred to the Scarborough Museum. It would appear, however, that the type-specimen of *Melania vittata* was, for some unknown reason, not transferred along with the others.

The late Rev. J. F. Blake, in his description of the species,[1] appears to have noticed the absence of a type-specimen in the Scarborough Museum, as he states: "Type is constituted by Phillips' figure only." It would thus appear that Blake came to the conclusion that no actual type-specimen existed.

The present is a good opportunity to call attention to a mistake made by both Blake[2] and Hudleston[3] in the date of Lycett's[4] description of this species. Both authors give 1853, whereas date should be 1863, otherwise the "Supplement" reads as if published before the "Monograph" of 1854. It is evident from the similarity of the mistakes that Blake copied Hudleston.

VII.—The Old Granites of the Transvaal and of South and Central Africa, by Cuthbert Baring Horwood, A.R.S.M., Assoc. M. Inst. C.E., F.G.S., with a Petrographical Description of the Orange Grove Occurrence, by Arthur Wade, B.Sc. (Lond.), A.R.C.S., F.G.S.

(*Concluded from the November Number, p. 507.*)

MR. GEO. G. HOLMES[5] and others have observed the remarkable and highly suggestive fact that not only do the schists (which contain in many places interlaminated beds of quartzites and massive crystalline limestone, e.g. in the Dwarsberg on the Magalakwin River in the Northern Transvaal) appear interbedded in the gneisses, but that the strike foliation and planes of schistosity of these old schists and of the gneisses seem invariably to be parallel.

This in itself appears to me to be strong evidence that these old

[1] *Fauna of the Cornbrash* (Pal. Soc.), 1905, p. 77. [2] Loc. cit., p. 77.
[3] Geol. Mag., 1882, p. 244.
[4] "Suppl. G. O. Mollusca" (Pal. Soc.), 1863, p. 14.
[5] Personally communicated. Also *vide* "Some Notes on the Geology of the Northern Transvaal", by Geo. G. Holmes (Trans. Geol. Soc. S.A., 1904, vol. vii, pt. 1, p. 52), and A. W. Rogers, loc. cit., p. 41.

schistose rocks were laid down on an old fundamental basement granite before the earth-movements occurred which induced the gneissoid structure of the granite; and it is therefore to the same causes which produce this gneissoid character that the schistose and foliated nature of these rocks is due.[1] Further, that the gneiss and schists have been so fractured, crumpled, and tilted, that a pseudo-stratification or interlamination of gneiss and schists has been produced.

Mr. Holmes has shown that these earth-movements have certainly extended up to later times than the Pretoria period. Thus, with reference to the South-Western Transvaal, he writes[2]—

"The most noticeable feature in the structure of this part of the country is a folding of the formations, the axis of which has a general north and south direction, due to pressure acting east and west. The main axis passes near Schweizer-Reneke northwards to the Kunana Reserve, along which line we find exposures of the primary granite. This line also divides the two great synclines of Dolomite and Pretoria Beds, one of which extends over the Kaap Plateau in Bechuanaland, and the other over the North-Western Transvaal in the Marico and Rustenburg districts.

"It is noticeable that this axis is coincident with the lamination of the gneiss, and that the pressure was prolonged in the same direction for a long period, acting most intensely on the oldest rocks; thus, whereas the quartzites immediately beneath the diabase at Schweizer-Reneke show comparatively gentle folding, the shales of Abelskop are crushed and folded to a great degree in the same direction."

I find that Mr. A. W. Rogers,[3] in describing the 'Keis Series[4] of Cape Colony, has given expression to a similar opinion with reference to the granite and gneiss and the quartzites and mica-schists which compose the 'Keis Series. He says—

"Along the greater part of their course the 'Keis Beds are flanked on either side by granite or gneiss, and areas of these rocks also occur in the heart of the series at Kaboom, Brakbosch Poort, and probably other places. At Boschiesman's Berg and Van Wyk's Pan tongue-shaped masses of gneiss project into the series from the great granitic area. These tracts of igneous rock are elongated in the direction of the strike of the 'Keis Beds, and the foliation and planes of schistosity of the two rocks are parallel.

"On Grenaat's Kop there is an inlier of 'Keis Beds surrounded by the Dwyka conglomerate, and a comparatively narrow dyke of granite traverses the inlier in a direction at right angles to the strike of the latter. The Grenaat's Kop dyke is the only clear case of intrusion of the granite in the 'Keis Series seen in the district. In other parts the contact of the igneous and sedimentary rocks has not been seen, owing to the thick covering of sand, and it would be possible to account

[1] It would seem probable that the later granitic intrusions were due to these same earth-movements.

[2] "The Geology of the South-Western Transvaal," by Geo. G. Holmes: Trans. Geol. Soc. S.A., 1906, vol. ix. p. 95.

[3] *The Geology of South Africa*, by A. W. Rogers, 1905 (Longmans, Green, & Co., London), p. 67.

[4] The geological horizon of these beds is above the Namaqualand schists, from which they are probably separated by an unconformity.

for many of the facts observed on the supposition that the 'Keis Series was deposited upon a floor of granite, and that at some subsequent period the rocks were intensely folded, so that on the one hand ridges of gneissose granite were formed projecting into the quartzites and schists, and on the other steeply folded synclines of the sediments went down into the granite." [1]

Mr. William Anderson, late Government Geologist of Natal, divided the Old Granites of Natal and Zululand into (1) fundamental granites, with gneisses and schists, and (2) newer intrusive granites.[2] The old crystalline schists, hornblendic, and other varieties, relics of a metamorphosed sedimentary formation, with interlaminated, coarsely crystalline limestones, he correlates with the Swaziland Series,[3] and thinks that the metamorphism of the limestone [4] is due to the intrusion of the granite. The gneisses he regards as probably sheared portions of the granite.[5]

The following is taken verbatim from his second report on the geology of Natal and Zululand: [6]—

"The granites, with their accompanying gneisses, schists, and less altered quartzites, conglomerates, etc., which are so well developed in the sub-coastal areas of Natal, the Engoye Mountains, and the Melmoth district of Zululand, present characters which are well worthy of mention. In these localities the occurrence of the granite among the gneisses and schists is remarkable, in that it is of a most erratic character. In the Engoye Mountains to the north-east of Eshowe it is present as a more or less distinct axis to the range, where it is flanked on either side by gneisses and schists. The less metamorphosed rocks of this series to the east and west of the range are not often visible, being covered by the newer formations; but at the Matikulu River-mouth in Zululand a small outcrop of granite occurs, and to the north-west, after crossing the Umhlatuzi River, the large area of the Melmouth district is formed of similar granitic and metamorphic gneisses and schists. Here the granite is not of the ordinary character of a simple intrusion, but is present on the outcrops as local areas among the gneisses and schists.

"In the Inchanga and Inanda districts of Natal the porphyritic granite there shows far more evidences of having been a locally intruded granite, while in the Engoye Range this feature appears to a less degree.

"The gneisses and schists associated so intimately with the local areas of granite seem to be quite distinct from the metamorphic slates,

[1] The origin of the Witwatersrand syncline can be explained in a similar manner.

[2] Second Report of the Geological Survey of Natal and Zululand, by Wm. Anderson, F.R.S.E., Government Geologist, 1904 (West, Newman, & Co., London), p. 13.

[3] Third and Final Report of the Geological Survey of Natal and Zululand, by Wm. Anderson, F.R.S.E., Government Geologist, 1907 (West, Newman, & Co., London), pp. 108–13.

[4] He says this limestone has undoubtedly originated as a sedimentary deposit, loc. cit., p. 111.

[5] Loc. cit., pp. 109, 113.

[6] Second Report of the Geological Survey of Natal and Zululand, by Wm. Anderson, F.R.S.E., Government Geologist, 1904 (West, Newman, & Co., London), pp. 11, 12.

quartzites, jasperoid rocks, and conglomerates which are present in the west of Zululand in the Nkandhla and Tugela Valley districts. The petrological character and mineralogical composition of the granites forming these erratically disposed areas usually vary much, and there seems little doubt that the gneissic and schistose series of rocks is of a much greater age than the metamorphic rocks, quartzites, jasperoid rocks, etc., above mentioned, and probably represents the oldest rocks of the Continent, the original basal series of this part of the world, which formed the backbone of Africa upon and around which all the younger sedimentary formations have been deposited."

He then says: "Whether this most ancient series of granites, gneisses, and schists are the same as the Namaqualand gneisses and schists I cannot yet say, but my friend Dr. Corstorphine informs me that lately he has identified a similar series of granitic gneisses and schists on the Limpopo River, to the north of Pietersburg. His description of the occurrence and character of these rocks on the Limpopo tallies exactly with this series on the East Coast which I have just mentioned."

Having now passed in review the most important work done on the Old Granites of South Africa during the last ten or eleven years, before summarizing the chief deductions which may be drawn from it, I will, very briefly, say a few words on the scenic and economic aspects of the gneiss and granite areas.

Scenic and Economic Aspects.

In describing the pre-Cape rocks of the south and west of Cape Colony, Mr. Rogers[1] states that the masses of granite and gneiss form the highest ground, with the exception of outliers of Table Mountain sandstone. In Griqualand West and Prieska they form most of the lower-lying country, seldom rising far above the generally sandy ground in hills or 'tors' as the granitic rocks do in Bushmanland and in the south-west districts of the Colony.[2] I have also noticed this feature of the granite country in the Prieska district, and have observed that as one travels further east the granites of Upington and of Southern Gordonia, generally near the borders of German South-West Africa, frequently rise into 'tors' or bare rugged hills, especially the more massive varieties.

In the Congo territory described by Preumont and Howe[3] the country is, of course, mostly covered with equatorial forest and the ground with a heavy layer of surface soil, so that outcrops are few and far between. The greatest elevations (3300 to 4000 feet) are attained in the Nile–Congo watershed. In the south-east and north-east the country is hilly or even mountainous; westwards it gradually becomes lower and monotonous, with broad undulations, out of which rise in places groups of isolated hills. A large extent of the Uelle district is very densely wooded; to the north of this forest area it consists of vast plains covered with grass and scrub, pierced by broad valleys covered with forest growth following the watercourses.

[1] *The Geology of Cape Colony*, by A. W. Rogers, 1905 (Longmans, Green, & Co.), p. 38.

[2] Loc. cit., p. 64.

[3] Loc. cit., p. 643.

Messrs. Chalmers and Hatch[1] have shown how very noticeably in Mashonaland and Matabeleland the physical features are largely dependent on the geology of the country. Thus the bulk of the country is granite, the remainder consists chiefly of schists, and the areas covered by granite present a bare, rocky, rugged aspect, which is remarkable for its uniformity over large areas, or else broad expanses of flat or rolling veld, from which rise here and there masses of immense boulders and rugged kopjes. At intervals the granite rises into wild mountain ranges. The schists occur as broad patches in the granite and form the gold belts of the country. Instead of the sandy sterile soil of much of the granite areas, the schists give rise to a clayey fertile soil, produce softer, less rugged, scenery, more undulating and hilly, with fertile valleys and well-wooded hills, owing to the more variable nature of the rocks and also to the fact that they are tilted at high angles so that they are more easily weathered.

Dr. F. W. Voit,[2] in describing the geology of German South-West Africa, says: "It is so easy to see at a glance the difference in the character of the landscape between a schistose and granite area." He speaks of the schist districts as presenting a very undulating land surface, from which rise hills to a height of from 1300 to 1600 feet, culminating in serrated kopjes and flat-topped ridges, and covered with thick bush and grass. In the granite area, on the other hand, rocks, like islands, rise out of a coarse-grained sandy floor with startling abruptness, or form characteristic half-coned hills or gigantic granite cones, almost completely barren of vegetation.

The copper deposits of this region occur in the schists and gneiss zones and not in the granite proper.[3] However, granite areas may also be undulating and fertile, as, for example, the granite boss between Johannesburg and Pretoria, which is only sparingly wooded.

Mr. W. Anderson[4] has pointed out that in metamorphic and granitic areas, where the rocks are more or less crystalline and contain chiefly quartz, felspar, hornblende, mica, etc., the soils resulting from the former (gneisses, schists, etc.) are generally of a decidedly clayey nature, while those derived from the latter are of a more sandy character, though still containing much clayey material from the decomposition of the felspars. Also that the chemical constituents of the ordinary minerals in these rocks—potash, alumina, silica, lime, magnesia, etc.—are such as are necessary for the formation of a good soil; and that the reason why granitic areas are not, except in rare cases, much used for agricultural purposes is a physical geological one, surface denudation of these rocks generally producing a very rugged country, which is always against the preservation of the soils for agricultural use; but where it happens

[1] "Notes on the Geology of Mashonaland and Matabeleland," by J. A. Chalmers and Hatch: Geol. Mag., 1895, Dec. IV, Vol. II, No. ccclxxi, p. 193 et seq.

[2] "A Contribution to the Geology of German South-West Africa," by Dr. F. W. Voit: Trans. Geol. Soc. S.A., vol. vii, pt. ii, p. 84.

[3] Loc. cit., pp. 77–94. Also *vide* "Copper Ore in South-West Africa", by J. Kuntz: Trans. Geol. Soc. S.A., vol. vii, pt. ii, pp. 70–6.

[4] Second Report of the Geological Survey of Natal and Zululand, by Wm. Anderson, F.R.S.E., Government Geologist, 1904, p. 23.

that any extensive area of moderate slope is covered with granitic soil, its quality is beyond dispute. He points out that the high angles of the slopes in a rugged granitic country accelerates the drainage from the soils, where they are present, of all the alkalies in solution, as well as the other soluble chemical ingredients, which are necessary to the formation of a productive soil; also that in some parts of the world granitic soils are of extreme richness from the presence in the granite of apatite, a mineral which is a natural phosphate.

These granitic areas are generally well watered, as, for example, in Natal and Zululand, the Johannesburg–Pretoria boss, the Limpopo region, and the Uelle and Lado Enclave provinces of the Congo Free State. Gold occurs in quartz-veins in the Old Granite in the Zoutpansberg district. At the Ayrshire mine[1] in Rhodesia gold occurs in an augite-diorite dyke traversing the granite. Tin occurs in pegmatite dykes in the Old Granite in Swaziland, at Embabaan; also in veins in the granite at Kuils River, near Cape Town. Probably payable deposits of kaolin, derived from the decomposition of the Old Granite, will in time be discovered.

Conclusions.

From the foregoing the following conclusions are derived:—

(1) In South and Central Africa there exists a Fundamental Granite-Gneiss Formation, which formed the nucleus or core of the continent, the base of the geological column on and around which the younger formations have been built up, and although later portions are intrusive in the Swaziland Series, nevertheless it underlies and supports it in much the same way that the Fundamental or Laurentian Gneiss of Canada is intrusive in and yet underlies and supports the Grenville Series.[2] In Eastern Canada, however, the original basement upon which the first sediments were laid down has nowhere been discovered, having been everywhere torn to pieces by the Laurentian Granite intrusions;[3] whereas in South Africa later portions of the Old Granite are intrusive in both the Fundamental Gneiss and also in the oldest existing sediments, and there is no reason to assume the pre-existence of still older sediments; but, as we have seen, there is good reason to regard the Old Gneiss as the original basement on which the oldest existing sediments were built up. This Fundamental Granite-Gneiss Formation is especially well developed in the region of the Limpopo, in German South-West Africa, in German East Africa, in parts of the Congo Free State and of the Nile Basin, in Mashonaland and Matabeleland, and also in Natal and Zululand.

(2) It follows from (1) that the Old Granites of South Africa, although all derived from similar, probably the same, magma, are not all of exactly the same age. Thus it would seem that the Old Granite

[1] *The Geology of South Africa*, by Hatch & Corstorphine, 1905 (Macmillan & Co.), p. 105.

[2] "On the Structure and Relations of the Laurentian System in Eastern Canada," by Professor F. D. Adams, D.Sc., F.R.S.: Quart. Journ. Geol. Soc., vol. lxiv, No. cclv, p. 146.

[3] Loc. cit., p. 147.

is intrusive in the Swaziland Series by after-protrusions due to the fracturing and crumpling of the old granitic crust produced by secular cooling. These intrusions have occurred at various intervals extending over vast geological time. For example, Dr. Molengraaff[1] has shown that the Old Granite boss of Vredefort is probably more recent than the Pretoria Formation.

(3) The increasing prevalence of granite and gneiss as one travels northwards towards Central Africa has already been noted. To the south and south-east the sediments are well developed. The elevation of the more northern portion and the progressive subsidence of that to south and south-east (and consequent depositions and building-up of the sediments of these latter areas) may probably be due to the same causes as those recently suggested by Dr. Adams[2] to explain the progressive uplifting of the Laurentian Highlands of Eastern Canada and sinking of the great plains to the south, namely, the uprising of the granite-magma from the depths accompanied by its withdrawal from below the subsiding areas.

(4) The gneisses of this formation are of igneous origin, and are probably granites altered chiefly by regional metamorphism. Possibly, however, some of the later gneisses, intimately associated with the crystalline schists of the Swaziland Series, are paragneisses, that is to say, are of sedimentary origin.

(5) The sediments of the Swaziland Series are derived from this Old Fundamental Formation, and possibly also in part from ocean-borne detritus.

(6) The Witwatersrand System has been derived from the Swaziland Series and the Old Granite which is intrusive in it, but probably to only a very small extent, if any, from the further removed Fundamental Granite-Gneiss Formation.

The Granite of Orange Grove.

By Arthur Wade, B.Sc. (Lond.), F.G.S., A.R.C.S.

(PLATE XXVII.)

The rock consists essentially of quartz, albite, microcline, orthoclase, biotite, and sphene, with apatite as a prominent accessory mineral; epidote, chlorite, sericite, and fluor are more or less common minerals of secondary origin. It is a biotite-granite, somewhat rich in soda. Under the microscope the rock is seen to be holocrystalline, hypidiomorphic, somewhat porphyritic, and coarse-grained. A tendency to graphic and micrographic structures are sometimes to be noted. Felspars, either orthoclase or plagioclase, are the most abundant minerals, the latter type being most frequent. The orthoclase is practically confined to an early generation of large porphyritic crystals. Microcline is very abundant in some sections and curiously rare in others.

[1] "Remarks on the Vredefort Mountain-Land," by G. A. F. Molengraaff: Trans. Geol. Soc. S.A., vol. vi, pt. ii, pp. 20–6.

[2] Loc. cit., p. 145. In Great Britain the sequence from the very oldest to the most recent rocks as one travels from the north-west of Scotland to the south-east shores of England is very marked.

The extinction angles show that albite is the dominant form, though a little lime-soda felspar is present. It is frequently idiomorphic with regard to microcline and orthoclase felspars. The mineral is usually very much altered, so much so that the twin lamellation is frequently obscured. The secondary products include the colourless micaceous mineral sericite, which is often included in minute flakes in the turbid interior of the crystals, or is present along cracks, probably developed by crushing, both in the plagioclase and in the microcline. Small greenish flakes of biotite are sometimes similarly included, whilst lemon-yellow grains of epidote are fairly abundant in the plagioclase.

A feature to be noted is the presence of clear, fresh, secondary soda-felspar bordering the altered plagioclase in places, practically in optical continuity with the original felspar lamellation (Pl. XXVII, Fig. 3), though occasionally the secondary material shows no such lamellation. The microcline contrasts markedly with the other plagioclase felspars by reason of its comparative freshness. It is sometimes quartz-like in its clearness. The typical cross-hatching is frequently beautifully shown. It contains idiomorphic crystals of the other felspars, as well as elongated blebs of quartz and flakes of biotite as inclusions. Sericitization has taken place along strain cracks in the mineral.

Quartz occurs in colourless irregular grains, sometimes enclosing flakes of biotite, sometimes wrapping round the felspars. Its occurrence inside the microcline simulates graphic structure, whilst micrographic intergrowths with orthoclase felspar are sometimes seen. The grains frequently tail off into or are partly bordered by crushed material. This, accompanied by undulose extinction in both quartz and felspars, shows that the rock has been subjected to severe crushing strains.

The biotite varies from pale yellow green to green in colour. Longitudinal sections are extremely dichroic: a pale yellowish brown, β and γ green, in unaltered sections. Pleochroic haloes are also common. The mineral has a strong birefringence. It encloses sphene, and sometimes a little sericite is intergrown with it. Epidote is frequently seen in large grains, very intimately associated with the biotite flakes. Chloritization is often seen to have been partly or wholly effected in some of the biotite, with a consequent weakening of the polarization effects. It is mostly seen running through the rock in strings or as groups of flakes enclosing the altered plagioclase crystals. Sometimes it occurs in tiny greenish scales scattered through the much altered felspars. These modes of occurrence, together with its constant association with epidote (Pl. XXVII, Fig. 1), suggest that the mineral is in part or even wholly of secondary origin.

Sphene is unusually abundant. It is reddish brown in colour, distinctly pleochroic, with high refractive index, strong birefringence, and strong dispersion of the optic axes ($\rho > v$). Double wedge-shaped crystals are characteristic, though curiously elongated forms are also present (Pl. XXVII, Fig. 2). It belongs to the earlier (porphyritic) generation of minerals present in the rock. Small colourless grains, with high refractive index, are sometimes present, and can be identified as sphene by their strong dispersion. Apatite also belongs to this early generation of minerals, and is a common accessory. It is present as

tiny needles, included chiefly in the felspars and biotites. Sometimes small aggregates occur, and these are especially associated with the biotite flakes. Large crystals, giving well-defined hexagonal basal sections (Pl. XXVII, Fig. 1), are also present. Epidote occurs in quite large grains and aggregates, sometimes forming a fairly large proportion of the section under consideration. It is of the pale lemon-coloured variety, distinctly pleochroic, and possessing strong birefringence. The large size and idiomorphic character of some of the grains give a first impression that the mineral may be primary. It is, however, always closely associated with much altered felspars, and is occasionally seen as small grains enclosed in them. It is therefore much more likely to be a secondary produce. Some colourless grains enclosed in the micas suggest the mineral zoisite, whilst others, exceedingly scarce, had two sets of cleavages at 70° with one another, and extremely weak birefringence. The characters suggest fluor, though on account of the very small size of the grains and the thinness of the section confirmation by chemical tests could not be obtained. The rock is a *Biotite Granite*, somewhat rich in soda, with much sphene and epidote.

An analysis of the rock, with a comparison with those of some of the best known British soda granites, and with that of the New Red Bushveld Granite of the Transvaal, may prove instructive—

	I.	II.	III.	IV.	V.	VI.
SiO_2 . .	78·61	70·48	63·34	72·084	80·24	75·84
TiO_2 . .	—	—	—	—	—	—
Al_2O_3 . .	7·76	14·24	15·28	14·459	12·24	11·14
Fe_2O_3 . .	4·51	3·72	6·88	2·399	0·72	4·68
FeO . .	1·69	—	—	—	—	0·01
MnO . .	—	—	—	—	—	tr.
CaO . .	2·60	1·48	4·34	1·762	0·89	1·04
MgO . .	0·90	0·40	2·48	0·105	tr.	0·27
K_2O . .	1·74	4·26	2·67	4·803	0·40	3·92
Na_2O . .	2·10	3·66	3·68	3·014	5·58	2·69
P_2O_5 . .	tr.	—	—	—	—	tr.
CO_2 . .	—	—	—	—	—	tr.
Li . . .	—	—	—	—	—	tr.
Moisture .	—	1·59	1·01	0·906	—	0·02
Loss . .	—	—	—	—	—	0·64
Totals . .	99·91	99·83	99·68	99·532	100·07	100·25
Spec. Grav.	2·712	2·593	2·713	2·634	2·629	2·626

		Age.
I.[1]	Orange Grove Granite, Transvaal. (Fresh.)	Pre-Carboniferous.
II.[2]	Grey Granite of Slieve-na-Glogh, Carlingford . . .	Post-Carboniferous.
III.[2]	Soda Granite, Newry. (Mean of two analyses.) . . .	,,
IV.[2]	Soda Granites of S.E. Ireland. (Mean of nine analyses.)	Pre-Carboniferous.
V.[2]	Soda Granite, Croghan Kinshela, S.E. Ireland . . .	,,
VI.[3]	Bushveld Granite, Roodepoortje (149), Transvaal. (Fresh.)	,,

[1] *The Witwatersrand and Associated Beds*, by C. B. Horwood, 1905 (Esson and Perkins, Johannesburg), pp. 70–1.

[2] Analyses quoted by Teall, *Brit. Petrog.*, 1888, pp. 310–50.

[3] C. B. Horwood, loc. cit., pp. 70–1.

A most interesting description of a rock very similar to that of Orange Grove will be found in the Memoirs of the Geological Survey of the United Kingdom, *Silurian Rocks of Britain*, 1899, vol. i, Scotland, ch. xxvi.

It will be seen that in all these cases the low percentage of alumina presents a close comparison with the Orange Grove rock, but some varieties of the rocks furnishing the means given in Columns III and IV approximate more closely to it in composition. A granite from Teufelsmauer, near Krems, mentioned by Zirkel in his *Handbuch*, has a similar low percentage of alumina accompanied by a high silica percentage.

On the whole the analysis bears out the observations made by means of the microscope. The abundance of sphene, however, in the rocks would lead one to expect some small quantity of oxide of titanium. The rock has one or two other peculiarities besides its low percentage of alumina. It is very acid, and yet has rather higher percentages of lime and iron than are usual in granites. The abundance of epidote accounts for the lime, and this, together with the presence of secondary albite, is somewhat significant. It suggests that oligoclase was originally one of the felspathic constituents, and this suggestion finds support in the presence of oligoclase in the more basic fresher varieties of this Old Grey Granite of the Transvaal as found at Rietfontein and Driefontein.

The peculiarities in the composition of the rock lead one to examine its position with regard to the classification of igneous rocks by quantitative methods lately proposed by distinguished American petrologists. Whilst not entirely accepting this American system and its elaborate nomenclature, the author feels bound to recommend it to the notice of all interested in petrology, as a step in the right direction; a foundation for a more perfect system of rock classification, which will enable us to comprehend more clearly their relationships and the laws which govern the origin of rocks. For further details with regard to the system and the methods and nomenclature used in the following calculations, the works on the subject published by the originators are recommended.[1] One or two words only can be spared here. Starting from the chemical composition of the rock as obtained by an actual analysis, the molecular proportions of the various oxides present in the rock are first worked out. From these the 'norm' or standard mineral composition of the rock, as contrasted with the 'mode' or actual mineral composition, is obtained by allotting the various oxides in molecular proportions to form certain 'normal' minerals. The allotment is performed according to certain fixed rules. Now by reason of the fixed set of minerals so obtained we are able to compare all rocks with a great amount of accuracy. These minerals are grouped as 'Salic' or 'Ferric' according as they are acid or basic in composition. The final classification is based primarily upon the ratios between these two groups of minerals, and, secondly, between the minerals of the 'norm'.

[1] *Quantitative Classification of Igneous Rocks*, by Cross, Iddings, Pirsson, and Washington, 1903 (University of Chicago Press).

MINERALS OF THE NORM.

	Percentage Composition.	Molecular Proportions.	Pyrite.	Ilmenite.	Magnetite.	Apatite.	Orthoclase.	Albite.	Anorthite.	Diopside.	Hypersthene.	Quartz.
SiO_2	78·61	1·310										
Al_2O_3	7·76	·076					108	204	48	44	51	855
Fe_2O_3	4·51	·028	·051				18	34	24			
FeO	1·69	·023								15	36	
MgO	0·90	·022								7	15	
CaO	2·60	·046							24	22		
Na_2O	2·10	·034						34				
K_2O	1·74	·018					18					
H_2O												
TiO_2												
P_2O_5	tr.											
	99·91											

Formulæ.	Molecular Proportions.		Molecular Weight.	Norm.			
SiO_2	855	×	60	Quartz	51·30	Q. 51·30	Salic.
$K_2O\ Al_2O_3\ 6\ SiO_2$	18	×	556	Orthoclase	10·01		
$Na_2O\ Al_2O_3\ 6\ SiO_2$	34	×	524	Albite	17·82	F. 34·50	
$CaO\ Al_2O_3\ 2\ SiO_2$	24	×	278	Anorthite	6·67		
$CaO\ SiO_2$	22	×	116	Diopside	5·23	P. 11·48	Ferric.
$MgO\ SiO_2$	7	×	100				
$FeO\ SiO_2$	15	×	132				
$FeO\ SiO_2$	36	×	132	Hypersthene	6·25		
$MgO\ SiO_2$	15	×	100				

$\frac{Sal}{Ferr}$	$= \frac{85{\cdot}80}{11{\cdot}48} > \frac{7}{1}$	. . . . Class I	Persalane.
$\frac{Q.F.}{C}$	$= \frac{85{\cdot}80}{0} > \frac{7}{1}$	. . . . Sub-class I	Persalane.
$\frac{Q}{F}$	$= \frac{51{\cdot}30}{34{\cdot}50} < \frac{5}{3} > \frac{3}{5}$	. . . . Order	Columbare.
$\frac{K_2O + Na_2O}{CaO}$	$= \frac{52}{46} < \frac{5}{3} > \frac{3}{5}$	. . . . Rang	Alkalicalcic.
	Name of Rang—**Riesenase.**[1]		
$\frac{K_2O}{Na_2O}$	$= \frac{18}{34} < \frac{3}{5} > \frac{1}{7}$	. . . . Sub-rang	Dosodic.
	Name of Sub-rang—**X.**		

The American authors suggest no name for this Sub-rang, since no rock of importance known to them seems to come here, though they are aware of analyses of rocks which would fill the blank. The Orange Grove Granite appears to be of sufficient importance to warrant us in assigning the name of *Orangose* to the sub-rang.

Rather significant, and showing to some extent the value of the system, is the fact that a similar rock from the Transvaal with minerals in similar proportions, with the exception of a large percentage of the basic constituents, is described by the American writers as *Vaalose*.[2]

DESCRIPTION OF PLATE XXVII.

Fig. 1. Biotite, with pleochroic haloes, associated with yellow epidote. Small flakes of green mica in the turbid plagioclase to the right. To the left, near the base, is a large hexagonal section of an apatite crystal. Power, $\frac{1}{2}$". Ordinary light.

,, 2. Large reddish-brown crystal of sphene, showing its unusually deep colour and elongated form. The turbid felspars contain unaltered patches, together with small grains of epidote and flakes of mica. Chloritic patches are shown. Power, $\frac{1}{2}$". Ordinary light.

,, 3. Turbid crystal of plagioclase, with clear secondary felspar in optical continuity. Microcline and micrographic intergrowth of quartz and felspar are shown. Sericite is shown in its usual form of development. Power, $\frac{1}{2}$". Crossed nicols.

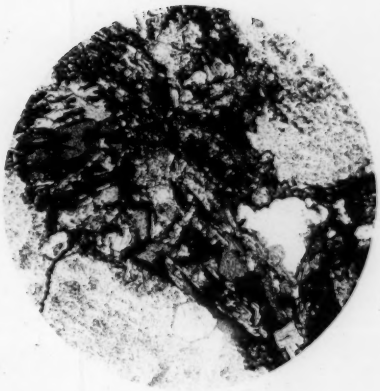
VIII.—Calc-Silicate Limestones of Donegal.

By Arthur E. V. Zealley, A.R.C.S. (Geologist and Curator of the Rhodesia Museum).

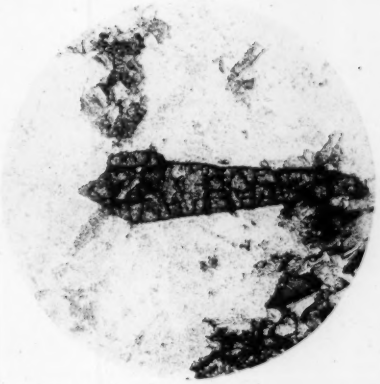
During the summer of 1908 I examined in the field the contact metamorphosed limestones of the county Donegal, my attention being mainly confined to those masses of limestone occurring as xenoliths in the granite. These strongly metamorphosed limestones frequently contain the interesting rock named by Dr. R. H. Scott 'Sphene-rock', which ("Granitic Rocks of Donegal": Journal of the

[1] "Alkalicalcic Rang of Columbare, the quarfelic order of Persalane, Class I, from the Granites of the Riesengebirge, Silesia": Milch. Neu. Jb., 1899, B. Bd. xii, pp. 152–222.

[2] "Dosodic Sub-rang of Vaalose, the Alkalicalcic Rang of Vaalare, the quardofelic order of Saltemane, Class III, Cohen": Neu. Jb., 1887, B. Bd. v, pp. 233–47.



1 x 30



2 x 30

3 x 30

Photo-Micro. Benerese, Colle, Perth

SECTIONS OF THE ORANGE GROVE GRANITES.

Geological Society of Dublin, 1861, vol. ix, p. 288) he describes as "occurring in actual contact with garnet limestones wherever we find these rocks". This Sphene-rock consists of allotriomorphic and hypidiomorphic felspars, with quartz, idiomorphic diopside and sphene, and in some localities zoisite, scapolite, etc.

It is my experience that the Sphene-rock always occurs *in* the limestone, and never represents the mixed rock at the margin of the limestone xenoliths. It generally takes the form of regular and definite granite veins intrusive in the metamorphosed limestone, the veins having absorbed material from that rock by their intrusion to considerably modify their original nature. The formation of this Sphene-rock is interesting, and has been studied by me in considerable detail. In practically every instance where the metamorphosed limestones contain granite veins the latter are of the nature of Sphene-rock, and this rock was not found to occur under any other conditions.

In a few localities the enveloping granite for an inch or so at the contact with the limestone contains sphene and a trace of pyroxene. At Annagary, a few feet of pyroxenic granulitic rock, also containing sphene, is developed at the junction of the limestone xenoliths with the enclosing granite.

It is my intention in the near future to describe at length elsewhere the Sphene-rock and its mode of occurrence, as well as the various types of metamorphosed limestone, which, for the sake of convenience in describing, I have arranged under several headings indicated by their mineralogical constitution, namely—

Garnet-calcite-pyroxene rock,
Garnet-Wollastonite rock,
Idocrase-calcite rock,
Epidote-actinolite-quartz rock,
Scapolite rock,
Actinolite-calcite rock,

as well as calc-silicate hornfels, pyroxene granulites, etc.

The chief localities examined were the following: Barnes Gap, Glen, Sessiagh Bay, Bunbeg, Annagary, Loughanure, Lough Atirrive, Poisoned Glen, Ardmeen, near Anure Lough, Dunlewy, Doochary Bridge, Glenleghan, Lough Nambraddan, Fintown, and Toberkeen.

The minerals noted in the calc-silicate limestones in addition to calcite are: Garnet, idocrase, pyroxenes, Wollastonite, tremolite, actinolite, pistacite, quartz, scapolite, zoisite, apatite, fluorite, and mica. Some of these minerals are particularly well formed, and have found place in most of the chief museums of Great Britain and Ireland.

IX.—Sedgwick Museum Notes.

On the Age of the Creechbarrow Limestone.

By Henry Keeping.

ON the north side of the outcrop of the Chalk in the Isle o Purbeck, there is an outlier of Tertiary beds the exact age of which has given rise to some discussion. There must be some

reason for the form of Creechbarrow Hill, and the outline suggests that it is due to some hard bed near the top, which we find on close examination to be a tough limestone, a considerable portion of which is hard and porcellaneous. The upper beds of this conical hill, which rises to a height of 637 feet above sea-level, are cut off from the adjoining masses, and therefore no continuous section can be traced to the well-known formations on the south or on the north. The section is further complicated by the occurrence of faults on both the north and south sides. We have, therefore, only the lithological character and fossil contents to depend upon for the correlation of the beds occurring in this outlier.

Mr. W. H. Hudleston has described the section at some detail in this Magazine,[1] and although he admits that the Creechbarrow Limestone resembles the Bembridge Limestone in some respects, he comes to the conclusion that it belongs to the Bagshot Series. Mr. Strahan[2] suggests the possibility that it may be the equivalent of the Bembridge Limestone. Mr. Hudleston speaks of the "thoroughly exceptional character of Creechbarrow in relation to the rest of the Tertiary beds in the neighbourhood", and quotes a workman who said "that Creechbarrow bulges all these beds and throws them out of line". But in his summing up he states "we cannot say what the hill itself consists of".

As I have stated above, the Survey has drawn faults on the north and on the south side of the outlier, and an overthrust is known to occur in close association, also there is room for unconformities between the Lower Tertiary and the Freshwater Series. I do not propose to discuss the structure, or to choose between faults, overthrusts, and unconformities. I merely wish to express the opinion that however it got there this limestone of Creechbarrow Hill is the equivalent of the Bembridge Limestone, and not of any part of the Bagshot Series, upon which it must rest discordantly.

After over sixty years of practical experience of this formation I hope it will be considered that I should know a piece of Bembridge Limestone, having worked it at the following places — Headon Hill, Cliff End, Sconce, Hampstead Point, Gurnet Bay, Binstead Quarries, St. Helens, Bembridge, and Whitecliff Bay. I know of no limestone in the Bagshot beds agreeing with the Creechbarrow Limestone in lithological character or fossil contents, but in the Bembridge Limestone we have the same kind of rock passing down in the same way through nodular concretionary beds into the underlying clay series.

In the Bagshot beds I know nothing resembling the lime-coated *Paludina* or *Melanopsis*, to whatever genus and species the Creechbarrow specimens may be referred. The remarkable fossil which has long been referred to as a cocoon, or the egg, first of turtle, and later of *Bulimus*, occurs at Creechbarrow, and if the shell of *Bulimus* could have been found I think the identity of the Creechbarrow and Bembridge Limestones might be considered proved. Seeing, therefore,

[1] New Ser., Dec. IV, Vol. IX, June, 1902, p. 241; Vol. X, April and May, 1903, pp. 149, 197. Proc. Dorset Field Club, vol. xxii, p. liv.

[2] "Guide to the Geological Model of the Isle of Purbeck": Mem. Geol. Survey.

that the interpretation of the geological structure of the district depends upon the correct determination of the age of this limestone, and we seem so near obtaining what would be regarded a crucial test, I am glad to announce that Professor Hughes has instructed me to carry out some not very extensive excavations which we hope may yield important results.

I would like here to thank Mr. A. H. Bloomfield for the valuable assistance he gave me during my recent visit to Creechbarrow, and I strongly recommend anyone who is visiting Dorsetshire for the purpose of studying its geology and collecting fossils to secure his services.

NOTICES OF MEMOIRS.

I.—New Faunal Horizons in the Bristol Coal-field.[1] By Herbert Bolton, F.R.S.E., F.G.S.

THE well-known rarity of animal remains in the Bristol coal-field is proving to be due rather to the concealment of the measures beneath newer rocks than to any actual absence of fossils.

In 1906–7 the writer determined the existence of four horizons each possessing a marine fauna, between the top of the Millstone Grit and the lowest workable seam in the Ashton district; and further work upon the beds lying above the Bedminster seam at South Liberty Colliery, Bedminster, and at Coalpit Heath in the north of the basin, has proved the occurrence of others. A section at South Liberty Colliery is as follows:—

Strata	127·4
Black Shale with *Anthracomya*	4·11
Strata	337·8
Grey Shale with *Anthracomya*	3·7
Strata	2·0
Dark grey Shale with shells	2·8
Strata	150·0
Black shell-bearing Shale	3·6
Strata	134·4
Bedminster Seam	3·0

At Coalpit Heath, a black shale forming the roof of the High Vein (Hollybush Vein of Parkfield) has proved exceptionally rich in specimens of *Leaia Leidyi*, var. *Salteriana*, whilst *Estheria* cf. *tenella* and *Anthracomya Phillipsi* also occur.

II.—Studies on the Structure and Affinities of Cretaceous Plants.[2] By Marie C. Stopes, Ph.D., D.Sc., F.L.S., Lecturer in Palæobotany, Manchester University, and K. Fujii, Ph.D., Assistant Professor of Botany, Imperial University, Tokio.

THE authors comment on the importance of the work done on the flora of the Palæozoic period, and the botanical interest that would attach to similar petrifactions of plants from all ages of the

[1] Abstract of paper read at British Association Meeting, Winnipeg, in Section C (Geology), August, 1909.

[2] Abstract of paper read before the Royal Society, May 27, 1909; communicated by Dr. D. H. Scott, F.R.S.

Mesozoic period. They have had the good fortune to find excellently preserved material from the Cretaceous of Northern Japan.

In the present paper they describe eighteen plants from this material, which is extraordinarily rich. As hitherto there has been very little known from anatomical material of plants of this age, the present paper is by no means final, but is in the nature of a pioneer chart of the ground.

The petrifaction of the cells of the plants is often extremely good, though the fragments are not so complete as could be desired. The plant-structures include stems, roots, leaves, cones, fern sporangia, and even an Angiospermic flower, the first petrifaction of a flower to be described. The débris lie together in the nodules in much the same way that the débris lie in the Coal-balls of the Palæozoic, though they are mixed with fragments of shells. The latter are largely Ammonites, and serve to determine the age of the petrifactions.

The flora as a whole represents an interesting mixed flora such as has not hitherto come to light among petrifactions.

Roughly speaking, the flora seems to have consisted of about one-third Angiosperms, slightly more than one-third Gymnosperms, and the rest of ferns and lower plants. The anatomy of the early Angiosperms being such a desideratum in botany, their presence in the petrifactions renders them doubly interesting, and particularly when they are found in so evenly balanced a mixed flora.

All the specimens described in this paper were cut in Tokio in the botanical department by the authors.

The plants described are as follows:—

Petrosphæria japonica, gen. et sp. nov. A fungus which has numerous microsclerotia, in the periderm of one of the Angiosperms, *Saururopsis*.

Schizæopteris Tansleii, gen. et sp. nov. The sorus and sporangia of a Schizæaceous fern.

Fasciostelopteris mesozoica, gen. et sp. nov. The stem and petiole of a fern with a dictyostelic anatomy. Probably allied to the *Dicksoniaceæ*.

Fern rootlets, in excellent state of preservation, showing the diarch stele of the leptosporangiate ferns.

Niponophyllum cordaitiforme, gen. et sp. nov. The leaf of what appears to be some plant of Cycadean affinity, the anatomy bearing considerable resemblance to that of *Cordaites*.

Yezonia vulgaris, gen. et sp. nov. A Gymnosperm, of which stems, unthickened twigs, leafy axes, are all very plentiful. It is the commonest plant in the material, and at the same time the most unique. In the anatomy of both main axis and foliage it is not like any known type.

Yezostrobus Oliverii, gen. et sp. nov. The fructification of a Gymnosperm, the cone bearing simple scales with seeds, one on each, which are like those of Cycads in some respects, but have a nucellus standing up entirely free from the integument with a well-marked epidermis between.

Though continuity is lacking between these two plants, there seems considerable ground for suspecting them of belonging to the same plant from anatomical points of likeness.

Araucarioxylon tankoensis, sp. nov. Secondary wood, showing remarkably clear pittings in the transverse sections.

Cedroxylon Matsumurii, sp. nov. Well-preserved secondary wood.

Cedroxylon Yendoii, sp. nov. Secondary wood, with traumatic resin canals.

Cunninghamiostrobus yubariensis, gen. et sp. nov. A cone, as its name implies, belonging to the family of the Cunninghamias, with its external appearance partly preserved and the cone scales and axis fairly well petrified. The seeds have apparently been scattered.

Cryptomeriopsis antiqua, gen. et sp. nov. Stem with leaves attached, the foliage very like that of a *Cryptomeria*.

Saururopsis niponensis, gen. et sp. nov. The stem and attached roots of an Angiosperm, probably to be included in the Saururaceæ.

Jugloxylon Hamaoanum, gen. et sp. nov. The secondary wood of an Angiosperm.

Populocaulis yezoensis, gen. et sp. nov. The stems of an Angiosperm, with cortical tissue.

Fagoxylon hokkaidense, gen. et sp. nov. The secondary wood of an Angiosperm.

Sabiocaulis Sakurii, gen. et sp. nov. Minute stems and older twigs of an Angiosperm, with cortex, and well-preserved and characteristic anatomy.

Cretovarium japonicum, gen. et sp. nov. The flower of an Angiosperm, of which there are several specimens.

Of this list of plants, the commonest, i.e. those which have yielded the greatest number of specimens in the course of the work, are *Yezonia*, *Sabiocaulis*, and *Cretovarium*. It is noteworthy that these are among the most unusual and the most interesting of the plants.[1]

REVIEWS.

I.—Igneous Rocks: Composition, Texture, and Classification; Description and Occurrence. By Joseph P. Iddings. In two volumes. Vol. I[2]: Composition, Texture, and Classification. 8vo; xi+464 pages, 130 figures, and 1 coloured plate. Cloth. New York, John Wiley and Sons; London, Chapman & Hall, Limited; 1909. 85 (21*s.*) net.

THIS is the first part of a new textbook of the petrology of Igneous Rocks, and is meant to serve as an introduction to an exposition of the 'quantitative' classification. For this reason special prominence

[1] The authors acknowledge much assistance in the work from the Royal Society Government Grant Committee, which made it possible for one of them (M. C. S.) to attempt the work; and from the various departments of the Imperial Government of Japan in the course of collecting and preparing the material.

[2] Vol. II: Description and Occurrence (in preparation).

is given to the chemical aspects of the subject. The earlier chapters are devoted to a brief account of the chemical characters of magmas and the principal means of representing these by diagrams. We then pass to a classification of the elements according to the periodic law, and the rock-minerals are considered according to their dominant components. It is difficult to see that anything is gained by this grouping, and it certainly leads to a good deal of repetition; the amphiboles, for example, are discussed under calcium, magnesium, iron, aluminium, and sodium. As regards the constitution of the silicates the views of Clarke are followed, but graphic formulæ are not used, probably because there is still too much uncertainty in applying them.

With the third chapter we begin the consideration of the application of the principles of physics and chemistry to magmas, and this portion of the work is entirely satisfactory, both in matter and in style. The exposition is lucid, though the treatment is brief; and for the benefit of those students who have not had a special training in physical chemistry the elementary principles of the subject are carefully expounded. No better introduction to the theory of the crystallization of rock magmas, regarded as solutions, could be provided for the use of students.

Some years ago a new descriptive terminology for rock structures was proposed by the author and a group of American petrographers. Without doubt greater variety and definiteness are needed in the language of descriptive petrology, and many of the terms proposed have already received general acceptance. This nomenclature is used here in the account of the texture of igneous rocks; much of it is excellent (for example, the suggestion that granophyres should be called graphophyres), and there are other kinds that are by no means unexceptionable. Thus mediophyric and mediiphyric, minophyric and miniphyric, as descriptive of porphyritic structures of different coarseness are more likely to cause confusion than to lead to clearness.

The book closes with a tabular statement of the 'qualitative' classification generally recognized in textbooks, and a condensed account of the principles of the new quantitative classification. This, and the chapter on the history of classification, have already appeared in print, and to English readers are likely to prove the least interesting part of the volume, as the space allotted to either system is too brief for any but a perfunctory treatment.

One of the most pleasing features of the book is the effort made to avoid the conventional methods of handling the subject, and to place new aspects and new examples before the reader. The author draws largely on the results of field-work among volcanic rocks in Western North America; and as the petrography of that region has been studied with extraordinary care, and it embraces a remarkable variety of igneous rocks, the instances cited to illustrate the general principles have a freshness and point which impress them on the memory.

J. S. F.

II.—An Introduction to the Geology of Cape Colony. By A. W. Rogers, D.Sc., F.G.S., and A. L. Du Toit, B.A., F.G.S.; with a chapter on the Fossil Reptiles of the Karroo Formation, by Professor R. Broom, M.D. Second Edition. 8vo; pp. xiii, 491, with geological map, 25 plates, and 29 text-illustrations. London: Longmans, Green, & Co., 1909. Price 9*s.* net.

WE welcome a second edition of this excellent handbook, the first issue of which, by Dr. Rogers, was reviewed in the Geological Magazine for 1905 (p. 135). Mr. Du Toit, of the Geological Survey of Cape Colony, is now associated with Dr. Rogers in the authorship. A new, clearly printed, and brightly coloured geological map has been prepared of the Colony, with bordering tracts of Natal, Basutoland, the Orange River Colony, and the Transvaal. Several new illustrations are given, but the size of the volume has been increased only by twenty-eight pages. The work has been carefully brought up to date, and some details of minor importance in the first edition have been reduced or omitted in order to keep the work within moderate limits. Attention was previously called to the somewhat meagre index, and in the new volume no references are given to any of the authorities quoted, an omission which, from a bibliographical point of view, is to be regretted.

The oldest known formations grouped under the name Pre-Cape rocks comprise "a heterogeneous collection of sediments and igneous rocks both extrusive and intrusive", all older than Devonian, but otherwise of uncertain age. They include the Campbell Rand Series, mainly blue dolomitic limestones, reckoned to be from 2000 to 3000 feet thick. Some of these beds are oolitic, some contain chert; there are also occasional altered sandstones or quartzites in the series, as well as dolomitic limestones that have been changed into rocks having the appearance and composition of quartzites.

The Table Mountain Series, which forms the base of the Cape System, is grouped with the Devonian, and appears to have been formed under desert conditions with fluviatile and lacustrine deposits. The succeeding Bokkeveld Series has yielded a fauna most nearly related to that of the Devonian of South America, and having relationship with the Middle Devonian of North America and with the Lower Devonian of Europe. The still newer Witteberg Series has yielded a number of plants, all the genera of which occur in the Carboniferous of Europe. Quite recently, however, the first traces of animal remains in the Witteberg Series have been recognized by Dr. H. Woodward (Geol. Mag., November, 1909, p. 486), the remains being portions of segments of Eurypterids, probably of the genus *Pterygotus*.

The Karroo System, with its basement Dwyka Series, includes representatives of strata belonging to Permo-Carboniferous, Permian, Triassic, and Jurassic ages. The term 'tillite', suggested by Professor Penck, is used for the Dwyka glacial conglomerate, which is a hardened form of boulder-clay. It has yielded remains of *Gangamopteris*. The shales above the tillite appear to be definitely of Permian age. At a higher horizon in the Ecca Series remains of

Glossopteris and other plants, as well as reptilia, occur. The Beaufort Series contains the well-known and remarkable series of reptilia, including *Pareiasaurus* and numerous other genera, as well as amphibia, fishes, freshwater mollusca, plants, etc. Dr. Broom, who contributes a chapter on the reptiles, remarks, "In probably no part of the world is there a formation of greater interest to the palæontologist, for here in the 14,000 feet or so of strata we have beds which when fully studied will yield us a continuous history of the land animals of one part of the world during a period of possibly over 2,000,000 years." The Stormberg Series, with its great series of volcanic beds, closes the record of Jurassic events.

The Uitenhage Series is separated from earlier strata by evidence of unconformity, and the latest researches on the molluscan fauna by Dr. F. L. Kitchin render it probable that the entire series is of Neocomian age. Higher Cretaceous strata are represented in the Pondoland Series, which includes Senonian and possibly also Danian.

The volcanic pipes and the occurrence of diamonds, the traces of possible Tertiary (thick sands with layers of clay and lignite), and the various Pleistocene and recent deposits are duly described, but we find no references to any discoveries of ancient stone implements. The discovery of *Mastodon* in gravels of the Vaal River is noted, and regarded as of Pleistocene age. Interesting observations are made on natural saltpans, on hot springs, water supply, and economic geology in general. There is also a chapter giving a summary of the geological history of the Colony, including reference to Professor Penck's view that the land is a bent surface of denudation, and that the position of the coast roughly marks the axis about which the bending has taken place.

In conclusion we may remark that the progress of geological knowledge is greatly aided by works like the one before us, and we wish that the geology of all countries, so far as known, could be dealt with in an equally judicious manner.

III.—The Guadalupian Fauna. By G. H. Girty, United States Geol. Surv. Prof. Paper 58, 1908.

In this comprehensive work we find much that is of interest to palæontologists generally. Three new families—Guadalupiidæ, Cystothalamiidæ, and Polysiphonidæ of the order Sycones, and seven new genera—*Anthracosycon* [order Lithistida, sub-order Tetracladina], *Virgula* [sub-order Tetracladina], *Pseudovirgula* [sub-order Tetracladina], *Stromatidium* [order Hexactinellida, sub-order Dictyonina], *Guadalupia* [order Sycones], *Polysiphon* [order Sycones], *Cystothalamia* [order Sycones]—are founded among the Spongidæ. The family Guadalupiidæ contains but one genus, and is distinguished by the mode of growth, "usually in lamellar expansions," and by the construction of the walls, "which are composed of tubes having a direction normal to the two surfaces, the superficial layers being reticulated and apparently formed of large, mutually consolidated spicules." The Cystothalamiidæ includes only one species and is

separated from the Sphærosiphoniidæ and the Sphærocœliidæ by the fact, among others, that the cysts are not separated into rings or segments, and from the Guadalupiidæ by not being composed of 'separate-walled' tubes and the want (?) of an outer fibrous layer. The Polysiphonidæ also includes one species and comes nearest to the Cystothalamiidæ. It differs from this latter in the possession of a solid instead of a perforated outer wall, in the absence of ostia, and "in having a definite and peculiar arrangement of the internal tubular structures, the tubes in *Cystothalamia* being more numerous, imperfect, chiefly radial in direction, and without any definite order of arrangement".

Among the Cœlenterata *Cladopora*, Hall, is recorded, apparently for the first time, from the Carboniferous. Several new forms of *Lindstroemia* are described. In a discussion of the first new species of this genus Girty treats of its relationship with *Lophophyllum*. Carruthers has more recently given a revised diagnosis of the latter and has shown that the type *L. konincki* is a young form of '*Cyathaxonia*' *tortuosa*, Mich., a form which cannot be a true *Cyathaxonia* on account of the presence of a well-marked dissepimental zone in mature growth-stages.

A new Cystid—*Cœnocystis*, n.gen.—has certain affinities with the Blastoidea, but is placed with the Cystoidea "because of the absence of large, regular, ambulacral areas and the presence of a large eccentric anal pore".

The section on the Brachiopoda is of more than usual interest. A new classification is submitted for the Orthotetinæ of the Strophomenidæ. *Streptorhynchus* and *Schuchertella* have neither septa nor dental lamellæ in the ventral valve. The former genus includes non-plicated forms which mostly have a high, distorted, ventral valve, "sometimes, possibly generally, attached by cementation." The dorsal valve is without an area and has a large cardinal process and well-developed socket plates. This genus would correspond to Waagen's 'Simplices'. Plicated forms which agree with the foregoing genus in other respects are so far without a generic designation. *Schuchertella* includes those shells which have a low, regular, ventral valve, peduncular attachment, a narrow distinct dorsal area, and a cardinal process, usually small. Plicated species are unknown. *Derbya*, *Orthotetes*, and *Geyerella* would be placed by Waagen in the 'Septati' and 'Camerati' divisions of his *Derbya*. Girty restricts the application of *Derbya* to non-plicated shells which possess a well-developed median septum in the ventral valve and have "the dental lamellæ more or less completely atrophied and discrete from the septum except at the apex" (= 'Septati' Waagen). Waagen's type of *Derbya* (*Derbya regularis*) belonged to this section. Plicated forms, of which only one species is known, have not yet been separated from the preceding. *Orthotetes* and *Geyerella* are included in the 'Camerati' division. The ventral valve possesses moderately developed dental plates which converge and unite and, with the pseudodeltidium, enclose a triangular pyramidal chamber. At their junction with one another the dental lamellæ also unite with the median septum, forming a triradiate figure. *Orthotetes* is restricted to the non-plicated forms, *Geyerella*

being applied to the plicated shells. Another group of Orthotetinæ is composed of species in which the ventral valve is provided "with two more or less parallel dental plates without median septum. The plates are prolonged to meet the anterior or convex wall of the shell". When the dental plates are long and parallel and the shells non-plicated, we have the genus *Orthothetina*. Plicated forms are placed under *Meekella*. Shells with short and diverging dental plates are without a distinctive designation.

The question might naturally be raised as to the value of septal development, external plications, areas, etc., in generic classification. It is probable that some workers, with Jakowlew, would minimize in any detailed subdivision the value of areas, or, with Scupin in "Die Spiriferen Deutschlands", the importance of septal division. Jaekel in his paper on phylogenetic development considers external characters to be only valuable for specific distinction. Presence or absence of external plications would, on this view, be insufficient for generic definition. Girty expresses a doubt as to whether all the features used for distinction are of equal taxonomic value, and applies the doubt particularly to the generic separation of *Orthotetes* and *Geyerella*, *Orthothetina* and *Meekella*. He would consider as appropriate for recognition *Streptorhynchus*, *Schuchertella*, *Derbya*, *Orthotetes*, and *Orthothetina*, but uses *Meekella* and *Geyerella* as genera in the monograph under consideration.

In discussing the cardinal process of *Streptorhynchus hallianum* as figured by [illegible] and Clarke, Girty suggests the probability that the cardinal process, like other areas of muscular attachment, "is subjected in old age to excessive shell secretion, not only increasing its size, but by strengthening its muscular features, also modifying its shape, so that the process varies much in both particulars, owing to difference in age." A somewhat similar opinion has been expressed by other palæontologists, e.g. Drevermann in his treatment of the *Spirifer* casts of the Devonian. Schellwien considered that the median septum was a development from the dental plates, a view which the author of the present work is inclined to dispute. He considers the median septum and dental plates to be independent structures, "though all converge and unite at the apex of the ventral valves, where they often merge in a solid shelly mass." It is interesting in the same connexion to note Jakowlew's opinion that a plate developed adjacent to the spondylium in *Cyrtina carbonaria* corresponds to a pseudodeltidium.

Martinia is based on the peculiarity of external configuration together with the absence of septal plates. The outer layer, when preserved, is assumed to be punctate. *Reticularia* is regarded as possessing well-developed dental plates and median septum. Some of the recent descriptions of *Reticularia* by Vaughan, Sibly, and others contain no reference to the presence of a median septum. Lee, therefore, makes the interesting suggestion, in his recent paper on the Nova Zembla Carboniferous Fauna, that there may be *Reticularia*-like forms possessing dental plates without median septum. Shells so characterized would probably be entitled to specific if not sub-generic value. McCoy's original diagnosis of *Reticularia*

emphasizes the presence of both dental plates and median septum. *Squamularia* includes forms which appear to bear the same relation to *Reticularia* in surface ornamentation as *Athyris* does to *Cleiothyridina*. It is further distinguished from *Reticularia* by the absence of dental plates and median septum. Gemmellaro originally established *Squamularia* on certain peculiarities of the brachia and the possession of flexuous lamellose expansions externally.

Heterelasma, a new genus of the Terebratulidæ, is based on peculiarities of internal structure. The names *Lyttodus*, *Composita*, and *Cleiothyridina* are employed in accordance with Buckman's usage instead of *Lyttonia*, *Seminula*, and *Cleiothyris*.

A new lamellibranch genus is described under the name *Protrete*. It bears a certain resemblance to *Pleurophorella*, from which it differs in having a tubular perforation under the umbones. This perforation is supposed to be a real opening into the interior of the shell. Other distinguishing features are the absence of radial ribs and papillæ. The general shape suggests *Lithodomus*, but the possession of the anterior opening distinguishes it from this as well as other genera which it outwardly approaches.

Peritrochia is a new Cephalopod belonging to the Pronoritidæ. "The most closely related genus is *Pronorites*. The suture of *Pronorites* is almost exactly that of *Peritrochia*, save that there is a tendency in the lobes toward a pointed, linguiform shape. The shape of the shell in *Pronorites*, however, is discoidal and the whorl section elongate and subquadrate, while the shell in *Peritrochia* is globose and the whorl section transverse and lunate. The umbilicus in one is wide and in the other closed."

Finally a new trilobite genus, *Anisopyge*, is described as belonging to the Proetidæ. It comes nearest to *Phillipsia*, but differs from that genus as typically found, in having a more pyriform glabella, smaller fixed cheeks, and also in other respects. One of the most marked features, however, is the presence in *Anisopyge* of thirty pygidial segments together with "a very striking discrepancy between the segments of the axis and those of the pleural regions, a discrepancy emphasized by the presence of an unsegmented band along either side of the axis".

Thirty-one excellent plates illustrate this valuable monograph.

IVOR THOMAS.

IV.—THE GEOLOGY OF ORE DEPOSITS. By H. H. THOMAS, M.A., B.Sc., and D. A. MACALISTER, Assoc. R.S.M. Illustrated. Crown 8vo; pp. xi and 416. London: Edward Arnold. Price 7*s.* 6*d.* net.

THIS work is the second of a series to be published under the editorship of Professor J. E. Marr, and intended chiefly for students of economic geology, but also for students of general geology, miners, surveyors, and others who are concerned with the practical applications of the science. To those who are familiar with ore deposits, the task of catering for such a wide range of readers within the limits of one small volume appears tremendous, and our heartiest

sympathy goes out to the authors when they say that they have found it fraught with much difficulty. But the work has been placed in good hands, and although others perhaps, under the same circumstances, might have sacrificed the numerous short notices of illustrative examples for more detailed descriptions of a few occurrences of ore, and abundant references to original works, the volume under review contains a wealth of information; and if, on closing it, we feel inclined to "ask for more", we may be sure that had the authors had greater space at their disposal, full justice would have been done to the subject.

The first chapter is an Introduction of twenty pages, that contain matter capable of expansion to four times the space. Then follow eight chapters, in which the authors classify ore deposits according to their mode of origin, under the following headings:—

Ores due to the differentiation of igneous magmas.
Pneumatolysis.
Hydatognesis—deposits formed by after-eruptive actions which are not pneumatolytic.
Ores due to metasomatic replacement.
Bedded ores due to precipitation.
Metamorphic ore deposits.
Secondary changes in ore deposits apart from metamorphism.
Detrital and alluvial deposits.

As the authors point out, any classification of ore deposits can only be arbitrary, and they themselves mention one objection to the above that will instantly occur to the reader, the difficulty of separating deposits formed by pneumatolysis from those formed by metasomatism, which is surmounted in this case by restricting metasomatism to aqueous solutions only. Nevertheless, this classification is easily followed and therefore good.

The best chapters in the book are, we think, that on ores due to the differentiation of igneous magmas and that on secondary changes. The illustrations are fair; but the index, which gives no names of localities, leaves much to be desired.

It would be unkind to the authors of this work to dwell on certain defects in the matter of clearness of statement, such, for instance, as that on p. 301, where precipitation is asserted to be dependent in all cases on the liquid being in a state of supersaturation with regard to the substance undergoing precipitation; or that on p. 14, where we are told that practically all tin-lodes are characterized by 'greisenization' of their walls. The former is logically correct, but requires explanation, while the second demands a very wide interpretation for the term 'greisen' before it can be accepted. However, such defects are perhaps difficult to avoid where 'boiling-down' is imperative, although a slight want of care in some quotations cannot be similarly excused. Again, detailed discussions on debatable points are, we know, out of the question, but we doubt whether every reader will agree with the authors in their treatment of the Witwatersrand conglomerates. In such a work as this it is surely better to state the arguments for and against, and leave the reader to form his own conclusion.

The account of the Bolivian tin deposits might have been improved by a reference to recent literature, even if its appearance was too late to enable the authors to modify the text; and again, the statement that the percentage of thoria in monazite occasionally rises to 6·5 is hardly in accordance with published analyses.

There is one defect in this book, however, that it is impossible to pass by without protest, and that is the frequent and totally unnecessary use of a termination that results in the terms 'acidic', 'sulphidic', 'oxidic', and 'satellitic'. We know that this hideous terminology did not originate with either of the authors; and when, some time ago, we saw it employed in an American magazine by one of them, we thought it due to editing. But that was a mistaken view, and we find now that we are expected to face with equanimity the phrase "oxidic and sulphidic compounds". Why not "oxides and sulphides"? On the other hand we are glad to see that the term 'vadose' occurs only once, and that as a quotation.

J. B. S.

V.—Journeys through Korea. By Dr. Bundjiro Kotô, Professor of Geology in Tokyo. Journ. Coll. Sci., Imp. Univ., Tokyo, 1909, vol. xxvi, article 2.

SIX years ago attention was called in the Geological Magazine (for 1903, p. 324) to "An Orographical Sketch of Korea" by Dr. Kotô. The present memoir gives the results of further studies and traverses of the country, and is accompanied by coloured geological sections and map of South Korea, and by 33 pictorial plates. The author refers to the pioneer work of Gottsche and Von Richthofen, the former of whom has quite recently been lost to science (see p. 575 *infra*).

The geological formations met with are arranged in sequence as follows:—

Alluvium.
Diluvium and younger effusives.
Tertiary.
Felsophyre and its allies.
Kyŏng-sang formation (Mesozoic).
Great granitoid series.
Phyllite schist (Metamorphic Mesozoic).
Kang-jin mica-schist.
Basal gneiss.

Korea is described as a land of granite and gneiss, and it is to be remarked that the age of the Phyllite schist has not been actually determined to be Mesozoic; it may, indeed, be very much older. Great intrusions of granite took place subsequently, "shattering the crust into diverse patches, and metamorphosing the sediments and ancient lava-flows and dykes into schistose and foliated rocks."

The lower portion of the Kyŏng-sang formation consists of red and grey sandstones, and red, green, and black marls; and the upper part of marls, shales, and breccia, all composed largely of igneous materials, with a covering of green porphyrite accompanied by felsophyre. Remains of plants, regarded as indicating the Malm-Dogger epoch of

the Jurassic, have been found in the lower strata in Korea; but the Kyöng-sang formation is more fully developed in Japan, where it includes representatives also of Rhætic beds and Lias.

Dr. Kotô gives particular descriptions of the igneous rocks, which were erupted at the close of the Kyöng-sang period (Mesozoic). The land was afterwards "dislocated and uplifted, depressed and remodelled, and the general outline of the peninsula was then complete. Since then, as in the case of China, the land of Korea has remained long in the Continental Period, and has been degraded from Alpine altitudes to hilly tracts; the materials from the ruined mountains forming in the meantime the Tertiary deposits near the seashore", on the east coast. Basalt was erupted during Tertiary times, but a much greater outpouring seems to have taken place during the Diluvial Period in North Korea. Otherwise this later epoch appears to have been "a lost period in the record of the deposits of the peninsula", owing to the fact that there was "intense sub-aerial degradation, and the wash has been carried down to the sea as fast as it has been formed". Much of the ground now remains a semi-desert and desolate, but the beginning of the Recent Period was marked by much snow and rain, by evidence of ice-action and of floods, which led to accumulations of debris along the slopes of the Piedmont Hills and choked the valleys with boulder gravel.

VI.—Geologists' Association.

In the Geological Magazine for February last (p. 96) we called attention to the Jubilee of the Association, and mentioned that arrangements had been made to commemorate the occasion by the issue of a volume that should deal with the geology of the districts of England and Wales to which excursions had been made since 1858, the subjects to be treated from the standpoint of our present knowledge. In the meanwhile there has been printed the very interesting presidential address by Professor W. W. Watts (Proc. Geol. Assoc., xxi, p. 119) on "The Jubilee of the Geologists' Association", wherein it is noted that the actual date of birth was December 17, 1858. Professor Watts has also given a short memoir, with portrait, of the first President of the Association, Toulmin Smith, who was a zealous worker on chalk sponges and flints.

We have now received Part I of the Jubilee volume, entitled *Geology in the Field*, edited by Messrs. H. W. Monckton & R. S. Herries. The size of the volume has proved to be much larger than was anticipated, and three further parts are promised. It is to be presumed that they will be continuously paged, and be supplied with an index. The present part, however, fills 209 pages, it contains seven articles, and is illustrated by four plates.

Middlesex and Hertfordshire are dealt with by Mr. J. Hopkinson; Essex by Mr. T. V. Holmes; Cambridgeshire, Bedfordshire, and West Norfolk by Mr. R. H. Rastall; Buckinghamshire by Dr. A. Morley Davies; and the Oxford and Banbury District by Mr. J. A. Douglas. These articles have been written generally on the plan previously

noted. There are two other articles, by Mr. F. W. Harmer, on the Pliocene Deposits of the Eastern Counties of England, and on the Pleistocene Period in the same area, the subjects being dealt with more purely from a stratigraphical and physical point of view, and without special reference to excursions made by the Geologists' Association. The second article, on the Pleistocene Period, is especially valuable in giving the matured views of Mr. Harmer on the glacial phenomena of East Anglia. He attributes the Contorted Drift (Lower Glacial) to the invasion of the land by ice coming directly from the North Sea, and the Chalky Boulder-clay (Upper Glacial) to the subsequent action of an inland glacier fed by ice which had crossed the Lincolnshire Wolds. His essay should do much to remove any scepticism that still remains with regard to the agency of land-ice in Britain during the Glacial Period.

VII.—Brief Notices.

1. British Pleistocene Canidæ.—Professor S. H. Reynolds read a paper before the Winnipeg Meeting of the British Association on the British Pleistocene Canidæ. Three species are found—the wolf, the fox, and the Arctic fox. There is no evidence of the existence in Britain in Pleistocene times of any animal that could be called a dog. The jaw described as *Lycaon anglicus* is thought by the author to be better regarded as a somewhat abnormal wolf. While, apart from any difference in size, the skull of a fox is readily distinguished from that of a wolf or dog by the depressions in the post-orbital processes of the frontals, it is extremely difficult, if not impossible, to find any valid distinctive character between dogs and wolves. The most useful character, for which we are indebted to Studer, is the orbito-frontal angle. He regards as belonging to wolves, skulls in which this angle measures 40°–45°; and as belonging to dogs, skulls in which the angle is greater than 45°. The author's measurements, while confirming Studer's contention that the angle in question tends to be decidedly less in the wolf than in the dog, show that the distinction is not absolute, and cannot be relied on in all cases.—*Nature*, October 21, 1909.

2. Norfolk and Norwich Naturalists' Society.—A general index to the Transactions of this Society, vols. i–viii, 1869–1909, has been prepared by Mr. C. D. Sherborn, and is issued with the concluding part 5 of vol. viii.

3. Plesiosaurs.—An article by Dr. C. W. Andrews, "On some new Plesiosauria from the Oxford Clay of Peterborough" (Ann. Nat. Hist., November, 1909), contains preliminary notes on some new types of Plesiosaurs and Pliosaurs, for which the generic names *Tricleidus*, *Picrocleidus*, and *Simolestes* are given.

4. Index for the London Library.—A comprehensive Subject-Index of the London Library, which contains more than 220,000 volumes, has been prepared by Dr. C. T. Hagberg Wright (1909). It is a quarto volume of 1254 pages, arranged alphabetically, with many

cross-references. The contents of proceedings of some of the learned societies and academies have been indexed fully under subjects, including the Kaiserliche Akademie der Wissenschaften zu Wien, the Palæontographical and Ray Societies, Smithsonian Institution, etc. A list of these is given, as well as lists of those proceedings partly catalogued in detail and others catalogued collectively. The work will be of the greatest value to students in art, literature, and science.

REPORTS AND PROCEEDINGS.

I.—Geological Society of London.

November 3, 1909.—Professor W. J. Sollas, LL.D., Sc.D., F.R.S., President, in the Chair.

The following communications were read:—

1. "Certain Jurassic (Lias–Oolite) Strata of South Dorset, and their Correlation." By S. S. Buckman, F.G.S.

(1) Descriptions are given of certain strata (Lower Bathonian to Pliensbachian) on the Dorset coast—Chideock and Burton Bradstock.

(2) Comparison is made with similar strata inland—with a summary of beds at Stoke Knap; with certain North Dorset strata; with Toarcian beds of Yorkshire and Northamptonshire.

(3) The strata described are classified according to what may be called the 'multizonal' or 'polyhemeral' system in the main, according to the scheme introduced for these strata in 1893 (5); but further divisions due to other investigators and to the author are dealt with.

(4) The strata described are arranged among thirty-six zonal (hemeral) divisions—a greater number of divisions than Oppel used in 1856 for all the Jurassic rocks, of which these beds form but a small part.

(5) The Upper Lias part of the Junction Bed of Down Cliffs, Chideock (Lower or pre-*striatulus* Toarcian) is a very condensed, imperfect epitome in 20 inches of about 80 feet of strata on the Yorkshire coast, and of very much more, allowing for gaps.

(6) Between the *bifrons*-layer and the *striatulus*-layer of the Junction Bed there is occasionally a 2 inch layer which is all that represents some 250 feet of deposit in the Cotteswolds—so that about 2 feet of Junction Bed were formed while some 550 feet were being deposited elsewhere.

(7) The Upper Toarcian (*moorei-dumortieriæ* hemeræ) makes a great show at Burton Bradstock and Down Cliffs as the Down Cliffs Clay and Bridport Sands (*pars*)—the greatest thickness of rocks of these dates in the country.

(8) The sequence of *aalensis*-strata above *moorei*-beds is demonstrated at Chideock Quarry Hill, in the upper part of the Bridport Sands.

(9) The Inferior Oolite (Aalenian, Bajocian, Bathonian *pars*) strata of Burton and Chideock are not counterparts of one another: they

supplement each other to a certain extent; both are incomplete, and much epitomized representatives of thicker deposits elsewhere.

(10) Mr. Thompson's zonal scheme for the Upper Lias is considered, and a table of Upper Lias zones for future work is presented.

2. "Certain Jurassic ('Inferior Oolite') Ammonites and Brachiopoda." By S. S. Buckman, F.G.S.

This paper is presented as a palæontological appendix, partly to the author's accompanying communication, partly to his previous stratigraphical work. In a short introduction the author, remarking on the fecundity of the 'Inferior Oolite' in the matter of species, makes the suggestion that this is due to the relatively great length of time taken up in its deposition; and he adduces data for supposing that the time thus occupied was from one-fifth to one-fourth of that for the whole Jurassic System.

The paper describes certain species of Ammonites and Brachiopoda which are important for the identification, the correlation, or the dating of Inferior Oolite deposits, and certain other notable species which, having frequently attracted attention in the field, require naming in the interest of future workers.

3. "The Granite Ridges of Kharga Oasis: Intrusive or Tectonic?" By William Fraser Hume, D.Sc., A.R.S.M., F.G.S.

The author quotes the detailed records given by Mr. Beadnell in his paper published in the Quarterly Journal for February, 1909 (vol. lxv, p. 41), and although in entire agreement with the facts there stated, differs with regard to the interpretation of those facts. Whereas Mr. Beadnell regards the granite as intrusive, on account of the high dip of the sedimentaries, and the changes which they exhibit as regards colour and hardness, near the granite, the author considers that the dips are due to fold-movements almost at right angles to one another, since they lie on the same line as the crater-like basins, the rims of which are formed of the compact and steeply-dipping limestones of the Lower Eocene, and he adduces as further evidence the fact that dykes and quartz-veins penetrating the crystalline rocks cease abruptly at the edge of the sandstone. He attributes the bright hues and silicification found near the contact to gases and heated waters acting along the boundary between the dissimilar rock-masses.

4. "The Cretaceous and Eocene Strata of Egypt." By William Fraser Hume, D.Sc., A.R.S.M., F.G.S., Superintendent, Geological Survey of Egypt.

The author divides the fossiliferous Cretaceous strata into three series—

(1) A northern Antonian type, marked by Cenomanian species, including typical Turonian strata.

(2) A central Egyptian or Hammama type, Cenomanian strata being absent, Campanian marked by abundance of *Ostrea villei* and *Trigonarca multidentata*, and phosphatic beds; the Danian portion having an eastern facies in which *Pecten*-marls are a characteristic

feature, and a western chalky limestone indicating a close affinity with the white chalk of Northern Europe.

(3) A southern or Dungul type, having close affinities with 2, but in the Campanian the phosphatic beds are inconspicuous, and the fauna consists of a group of specialized sea-urchins and of Gasteropods among which *Turritellæ* are very prominent.

The author emphasizes the uniformity of the Lower Eocene throughout Egypt, its triple subdivision being recognizable over vast areas. In the Middle Eocene this uniformity is replaced by differentiation, the well-known regions of the Fayûm and the Moqattam Hill differing from the succession in the area selected as typical in this paper. In the latter, five zones have been recognized in the lower division, while in the Upper Moqattam the *Turritella*-beds and the strata rich in *Carolia placunoides* and *Plicatula polymorpha* are of zonal importance. The Lower Moqattam is considered as beginning with the *Nummulites gizehensis* zone and closing with the *Gistortia*-bed, to the significance and extent of which attention is especially directed.

The author discusses the relation between the Cretaceous and Eocene beds, and points out that they differ lithologically, limestones being dominant in the Lower Eocene and shales in the Upper Cretaceous.

Palæontologically, great groups such as the Ammonites still abundant in the Upper Cretaceous disappear in the Eocene and are replaced by the characteristic nummulinid Foraminifera. On the other hand, both periods bear a strong resemblance to each other in the dominance of oysters and sea-urchins over other forms. A notable feature is the comparative rarity of Brachiopoda in Egypt throughout both periods, nor have Belemnites been recorded from the Egyptian Cretaceous.

Among post-Eocene formations the calcareous grits are shown to have a wide extension; but in the desert they differ in character from the mammal-yielding beds of the Fayûm. The question as to the Upper Eocene or Oligocene age of these beds is left over.

The quartz-chert gravels appear to be closely related to the calcareous grits, but are unconformable upon them. This continental phase is accompanied by volcanic and geyser activity.

The Cretaceous Period in Egypt was therefore one, in the main, marked by the gain of sea over land, the Eocene was one of rest, while at the close of the Eocene and during the Oligocene the approach of a continental phase is clearly indicated.

II.—Mineralogical Society.

November 16.—Professor W. J. Lewis, F.R.S., President, in the Chair.

(1) On an occurrence of Native Copper with Tin Ore in the Federated Malay States; by Mr. J. B. Scrivenor. In concentrates obtained in the final washing of the tin ore from the Rotan Dahan mine, in the district of Kinta Perak, the cassiterite was found to be mixed with a reddish mineral, which could not be separated from it. This proved to be

native copper in minute and beautifully sharp crystals. The tin ore is obtained from a mass of partially decomposed soft schists overlying limestone, and the copper was probably the result of reduction in situ of a copper salt held in solution by water percolating through the schists.—(2) On a Meteoric Stone from Simondium, Cape Colony; by Dr. G. T. Prior. Two or three masses of a meteoric stone were discovered in 1907, 100 yards apart and a foot below the surface, in gravel near Simondium Station, on the Paarl to French Hoek line, in Cape Colony. The masses, of which the largest was not more than a foot in diameter, were broken up by the finders, who supposed the particles of nickel iron seen on the fractured surfaces to be native silver. Six of these fragments, which were preserved, have been presented to the British Museum collection by Mr. R. T. Hancock and Mr. R. H. Stanley, one of the prospectors who discovered the masses. The meteorite belongs to the less common class of aerolites which show no chondritic structure; it consists of enstatite, olivine, and felspar, with nickel-iron, magnetite, and some troilite.—(3) On the occurrence of Alstonite and Ullmannite (a species new to Britain) in a Barytes-Witherite vein in the New Brancepeth Colliery, near Durham; by Mr. L. J. Spencer. A large vein of barytes coinciding with a fault in the New Brancepeth Colliery is worked commercially on a large scale for barytes, and has yielded many finely crystallized mineral specimens. These include barytes and witherite in large crystals, and the rare species alstonite and ullmannite (Ni Sb S, with 28 per cent. of nickel), the latter of which has not been previously recorded in the British Isles. Galena, blende, copper-pyrites, iron-pyrites, and melanterite are also present in small amount. The order of formation of the non-metallic minerals is (1) barytes, (2) witherite, and (3) alstonite, the two last having been derived from the barytes. The ullmannite is found as cubes of considerable size and as *octahedra*, and it sometimes forms a parallel intergrowth with galena.—(4) On Sartorite and other Minerals from the Binnenthal; by Professor W. J. Lewis. A crystal of sartorite showing twin lamellæ was described.—A pocket sclerometer was exhibited by Mr. C. J. Woodward.

III.—Zoological Society of London.

November 9, 1909.—S. F. Harmer, Esq., M.A., F.R.S., Vice-President, in the Chair.

A paper was read by Sir Henry H. Howorth, D.C.L., F.R.S., F.Z.S., on "Some Living Shells, their Recent Biology, and the Light they throw on the Latest Physical Changes in the Earth.—I. *Mya arenaria*". He stated that *Mya arenaria*, or the Clam-shell, is widely distributed in the North Boreal, European, and North American seas, and claimed to prove that it is a recent migrant into the former, and has probably not been there more than 300 years. The notion that it is an Arctic shell is a mistake. In the Arctic lists *Mya truncata*, var. *oblonga*, has been mistaken for it, and the glacial character of the beds in which it has occurred, which has been

postulated from its occurrence there, has accordingly been a wrong inference. Brögger has argued that it migrated from America. It was abundant in the Crag seas, and occurs in derivative fragments in the Drift beds, but it does not occur in the estuarine deposits or raised beaches, proving that after the period of the Crag it became extinct in Europe and has since been reintroduced. He regarded the cause of its extinction as a mystery, since the group of estuarine shells with which it is found has lived continuously in Europe since later Crag times.

In the course of his paper the author gave some interesting information on the changes known to have taken place in the Baltic, which at one time was a freshwater lake; afterwards it became freely open to the North Sea, and possessed an abundance of marine shells, with *Ostrea* and *Balani*, of large size. Lastly, so restricted became its supply of salt water, and so largely affected by the fresh waters of the great rivers which flow into it, that its marine fauna had gradually been killed off, or had become so dwarfed and malformed as to be hardly recognizable.[1]

CORRESPONDENCE.

THE USE OF THE TERM 'LATERITE'.

Sir,—Since writing to you on the use of the term *laterite*, two papers have appeared that illustrate the confusion surrounding the name at the present day. One of these is Mr. Mennell's "Note on Rhodesian Laterite" (Geol. Mag., August, 1909), and I shall be glad if you will permit a few further remarks in connexion with it.

Mr. Mennell agrees with Dr. Maclaren in considering that an essential condition to the formation of laterite is the alternation of perfectly distinct wet and dry seasons; in fact, Mr. Mennell says that this is the essential condition. Now, although throughout the Federated Malay States the rock called 'laterite' by engineers is, as far as I am aware, ironstone deposited in weathered rocks, there is in the State of Malacca an occurrence of rock that agrees with Dr. Francis Buchanan's definition of laterite; and in that it can be dressed with an axe, and hardens on exposure to the atmosphere, has proved of great utility in buildings, as can be seen in the old Portuguese church that crowns the hill in Malacca Town. This Malacca rock would, I believe, be accepted by all as laterite, and carries with it the idea of 'brick', on which the name was founded.

When Dr. Maclaren's paper appeared in 1906 I was struck by his remark on the necessity of alternating wet and dry seasons, since my impression was that no such alternation exists in Malacca; and when I saw the point emphasized by Mr. Mennell, I wrote to the Medical Officer in Malacca asking for the figures of monthly rainfall for any

[1] See H. H. Howorth, "The Recent Geological History of the Baltic": Geol. Mag., 1905, pp. 311, 337, 407, 454, 550.

three consecutive years, and received figures for 1906, 1907, and 1908, as follows:—

	1906.	1907.	1908.
	Inches.	Inches.	Inches.
January	3·12	2·57	2·27
February	4·19	1·99	3·62
March	4·63	3·53	3·48
April	6·65	5·55	5·53
May	6·61	7·30	4·23
June	6·71	6·57	3·49
July	6·42	6·32	4·22
August	10·82	4·92	9·12
September	5·97	5·65	10·75
October.	10·60	9·32	6·69
November	3·81	8·35	6·86
December	11·03	9·28	4·66

I think it will puzzle anyone to find evidence in the above for alternating and perfectly distinct wet and dry seasons. Mr. Kilroe doubts the necessity of tropical conditions for the formation of laterite, and as there is no reason whatever for supposing that the Malacca laterite was formed under conditions of rainfall differing from those that obtain now, it appears that alternating wet and dry seasons are not necessary either. J. B. Scrivenor.

Geological Department, Kuala Lumpur,
Batu Gajah, Federated Malay States.
October, 1909.

OBITUARY.

CARL GOTTSCHE, Ph.D.

Born 1855. Died October 11, 1909.

We regret to record the death of Professor Dr. Carl Gottsche, Director of the Mineralogical-Geological Institute at Hamburg. Born at Altona in Schleswig-Holstein, he early gave attention to geology, and in 1875 described a boulder of sandy limestone found at Eimsbüttel near Hamburg, which contained *Paludina lenta*, *Planorbis euomphalus*, and *Unio Solanderi*, characteristic of the Headon Beds. In 1878 he published papers on the Miocene Mollusca of Reinbeck, and on some Jurassic fossils from the Argentine Cordilleras; and in 1883 he issued a little work, *Die sedimentare Geschiebe der Provinz Schleswig-Holstein*, which was published at Yokohama. At that date Dr. Gottsche was engaged in a geological study of Korea, and in addition to other papers on the results of his work, he communicated to the Berlin Academy in 1886 a Geological Sketch of Korea, with the first geological map that had been made of the country.[1] Dr. Gottsche attended the London meeting of the International Geological Congress in 1888, and was also present at the British Association meeting at Bath in the same year. Those who attended some of the geological excursions in the west country will remember his keen interest and buoyant spirits in the field; and all will lament his decease at the age of 54. H. B. W.

[1] Dr. Gottsche obtained a recent specimen of *Pleuratomaria Beyrichii* at Enoshima, Japan, described by H. Woodward, Geol. Mag., 1885, pp. 433–9, Pl. XI, Fig. 1.

THOMAS ROXBURGH POLWHELE, J.P., D.L., M.A., F.G.S.

Born 1831. Died September 2, 1909.

Mr. Polwhele, who graduated at Cambridge, joined the Geological Survey under Murchison in July, 1857, and in the following year became a Fellow of the Geological Society. He was engaged in the mapping of parts of Oxfordshire and Buckinghamshire, and drew boundary-lines, which have proved to be substantially correct, for the clayey equivalents of the Corallian rocks between Wheatley and Quainton. He also surveyed areas of the Bagshot Series and other formations on the borders of Hampshire and Surrey. His geological notes were published in memoirs by his colleagues Mr. Whitaker and the late Professor A. H. Green.

Having succeeded to an estate at Polwhele, near Truro, he resigned his post on the Geological Survey on March 3, 1862. He was chosen President of the Geological Society of Cornwall in 1896 and 1897, and delivered addresses on "The Relation of other Sciences to Geology" and on "The Physical Geology of the Earth". He died at his Cornish home, aged 78.

MISCELLANEOUS.

Retirement of Mr. W. A. E. Ussher, F.G.S., of the Geological Survey of England.—Mr. W. A. E. Ussher, who joined the staff of the Geological Survey early in 1868, retired on September 30, after a service of more than forty-one years. Commencing work on the borders of the Mendip Hills, he has surveyed and mastered the geological structure over a continuous tract of ground extending from that region through Bridgwater to the Quantock Hills, and through the vales of Taunton, Honiton, and Exeter to Plymouth and the Cornish borderland. Although the main features in the geology had been represented on the old one-inch maps of De la Beche, the re-survey was to all intents and purposes a new one as regards details of the strata and tectonic features. To Mr. Ussher we owe the recognition and mapping of the subdivisions of the New Red rocks from West Somerset to the south coast of Devon, the first account of which was published in the Geological Magazine for April, 1875. To him also our knowledge of the subdivisions, the palæontology, and the foreign equivalents of the Devonian rocks of South Devon is most largely due. His strenuous and long-continued labours on the geology of that intricate district demanded not merely enthusiasm but an amount of physical energy unsurpassed. In other regions he was occupied for shorter periods, among the Jurassic rocks and drifts of North Lincolnshire, and in the survey of the superficial deposits on the borders of Greater London and in parts of the south-east of England.

Change of Name.— Bibliographers should take note that Mr. H. B. Muff, F.G.S., of the Geological Survey of Scotland, has changed his name to Maufe.

INDEX.

AFFINITIES of Triassic Plant, *Yuccites vogesiacus*, E. A. Newell Arber, 11.
Africa, Old Granites of, C. B. Horwood and A. Wade, 455, 497, 543.
Age of Creechbarrow Limestone, Henry Keeping, 555.
Albitization of Basic Plagioclase Felspars, E. B. Bailey & G. W. Grabham, 250.
Allophane, Note on a Deposit of, 222.
Anaspidacea, Living and Fossil, Geoffrey Smith, 425.
Ancient Egypt and Post-Glacial Time, Edward Greenly, 537.
Andover, Geology of, A. J. Jukes-Browne, 38.
Andrews, C. W., D.Sc., Mandible of a New Species of *Tetrabelodon* from Kansas, 347.
Antarctic Ice, Flow of, R. M. Deeley, 370.
Arber, E. A. Newell, Affinities of Triassic Plant, *Yuccites vogesiacus*, 11.
Archæan or Lower Palæozoic Rocks, Malay Peninsula, J. B. Scrivenor, 330.
Artesian Wells, Mutual Interference of, H. J. L. Beadnell, 23.
Artiodactyle, New, from Majorca, Dorothea M. A. Bate, 385.
Ashton, W., Battle of Land and Sea, 522.
Australia, Diamond Matrices of, J. Allan Thomson, 492.
Australia, Western, Extinct Marsupials of, B. H. Woodward, 210.

BAILEY, E. B., Albitization of Basic Plagioclase Felspars, 250.
Bassler, Ray S., Formation of Geodes, 323.
Batcombe, Somerset, Middle and Upper Lias Sections near, L. Richardson, 540.
Bate, Dorothea M. A., New Artiodactyle from Majorca, 385.
Bather, Dr. F. A., 47; Fossil Representatives of the Worm *Polydora*, 108; *Tetracrinus* (?) *felix*, from the Red Crag, 205.
Battle of Land and Sea, William Ashton, 522.
Beadnell, H. J. Llewellyn, Artesian Wells, Mutual Interference of, 23; an Egyptian Oasis, 476.
Beevor, Sir Hugh, The Dawn of Human Intention, 430.
Bernard, H. M., 92.
Bivalves, Silurian, Melbourne, 42.
Bolton, Herbert, Bristol Coal-field, 557.
Bonney, T. G., Scandinavian Ice-sheets and British Glacial Drifts, 188.
'Borolanite' from Am Meallan, Rossshire, Composition of, W. Campbell Smith, 152.
Boulder Distribution, Lennoxtown, Scotland, A. McEwen Peach, 26.
Boulders of Cambridge Drift, R. H. Rastall & J. Romanes, 284.
Bovey Deposits, Depth and Succession of, A. J. Jukes-Browne, 137, 257.
Brachiopods, The Attachment of, as Basis of Genera and Species, N. Yakowlew, 426.
Brazil and the Cape, Genus *Hastimima* from, Henry Woodward, 486.
Bristol Coal-field, Herbert Bolton, 557.
British Association for the Advancement of Science (Winnipeg), Address to Section C (Geology), A. Smith Woodward, LL.D., 413; Papers read in Section C, 473; Papers read in other Sections, 474–5.
British Museum (Natural History), Appointment of Keeper of Zoology, 95.
Bromhead, C. N., Solution Theory of Valley Formation, 142.
Broom, Professor R., Skull of *Tapinocephalus*, 400.
Brown, H. Y. Lyell, Mineral Discoveries in Northern Territory of South Australia, 323.
Brydone, R. M., Trimingham Chalk, South Bluff, 189; New or imperfectly known Chalk Polyzoa, 337, 398.
Bryozoa (Polyzoa), 337, 398.
Buckman, S. S., Jurassic Strata, South Dorset, 570; Jurassic Ammonites and Brachiopoda, 571.
Bunter Conglomerate, West Somerset, Source of the Limestone Pebbles, Edgar C. Martin, 160.
Burning Cliffs, Lyme Regis, "Passer Vennensis," 89; A. J. Jukes-Browne, 228; A. C. G. Cameron, 336.

CALC-SILICATE Limestones, Donegal, Arthur E. V. Zealley, 554.
Californian Earthquake, R. D. Oldham, 45; Earthquake of April 18, 1906, Andrew C. Lawson, 319.
Cambridge Drift, Boulders of, R. H. Rastall & J. Romanes, 284.
Cambridgeshire Gravels, Palæolithic Implement found in, J. E. Marr, 534.

Cameron, A. C. G., Well-section and Fossils at Ware House, near Lyme Regis, 169; Burning Cliff, Lyme, 336.
Canada, Department of Mines Reports, 41; Maritime Provinces of, Geological Cycles in, G. F. Matthew, D.Sc., 125.
Canidæ, British Pleistocene, 569.
Cantrill, T. C., *Spirorbis*-Limestones in 'Permian' of Coalfields, 447.
Cape Colony, Fossil Plants from Witteberg Series of, A. C. Seward, 482; Introduction to Geology of, A. W. Rogers, 561.
Cape of Good Hope, Geological Report on, 41; Geology, 561.
Carboniferous Limestone, Cracow, Stratigraphy of, J. Jarosz, 375; co. Clare, J. A. Douglas, 378.
Carboniferous Rocks of Scotland, Higher Crustacea of, B. N. Peach, 76.
Caribean Region, Geological Connexions of, R. J. Lechmere Guppy, 429.
Carus-Wilson, C., The Pitting of Flint Surfaces, 329.
Cassiterite and Specular Iron, Association of, in Lodes of Dartmoor, Donald A. MacAlister, 402.
Caucasus, Discovery of Trias in the, 171.
Cauldron Subsidence of Glen Coe, C. T. Clough, H. B. Muff, & E. B. Bailey, 327.
Centenary of Geological Society, London, Record of, Prof. W. W. Watts, 181.
Cephalopods from Tyrol, G. C. Crick, 443.
Chalk, Dry, Valley Features, R. H. Chandler, 538.
Chalk Downs, Kent, Surrey, and Sussex, Sculptures on, George Clinch, 284.
Chalk Polyzoa, new or imperfectly known, R. M. Brydone, 337, 398.
Chalk Rock, Contribution to the Fauna of the, C. P. Chatwin & T. H. Withers, 66.
Chalk Section, Waterworks Quarry, Marlow, C. P. Chatwin & T. H. Withers, 123.
Chandler, R. H., Erratic Boulders in South Pembrokeshire, 220; Note on a Deposit of Allophane, 222; Dry Chalk Valley Features, 538.
Charkow, Russia, Palæozoic Strata of, N. Yakowlew, 78.
Chatwin, C. C., & T. H. Withers, Fauna of Chalk Rock, 66; Chalk Section, Waterworks Quarry, Marlow, 123.
Chrysolite, Chrysotile, and Karystiolite, John W. Evans, 286.
Classification of Permian in North-East of England, David Woolacott, 513.
Cliff Formation, Brighton, E. A. Martin, 138.
Climate and Time, R. M. Deeley, 287.
Clinch, George, Sculptures of Chalk Downs of Kent, Surrey, and Sussex, 284.
Clough, C. T., & J. Kirkpatrick, Scottish 'Eenie' Coal, 229.
Clough, C. T., H. B. Muff, & E. B. Bailey, Cauldron Subsidence of Glen Coe, 327.
Coal, Scottish 'Eenie', C. T. Clough and J. Kirkpatrick, 229.
Coal-field, Bristol, Herbert Bolton, 557.
Coal-fields, S. Staffordshire and Warwickshire, *Spirorbis*-Limestone in 'Permian' of, T. C. Cantrill, 447.
Coal-measures, Lower, Derbyshire, Notts, and part of Yorkshire Coal-field, R. D. Vernon, 289.
Coal Pebble in a Coal-seam, W. S. Gresley, 157.
Coal-seams, Concretions in, Stopes and Watson, 37.
Coast Erosion, Geological Conditions affecting England and Wales, W. Whitaker, 49, 113.
Cockerell, T. D. A., Tsetse Fly in the Miocene, 228.
Codrington, T., Victoria Falls (Rhodesia), 233.
Collins, J. H., Geological Features at China Clay Pit, Cornwall, 138.
Colour-marking on Fossil Mollusca, 43.
Concretions in Coal-seams, Stopes and Watson, 37.
Convection Currents in the Earth's Interior, Rev. O. Fisher, 8.
Conway Succession, G. L. Elles, 136.
Conwentz, Professor H., Care of Natural Monuments, 429.
Coral Reefs, Formation of, Dr. F. Wood Jones, 428.
Cornwall, Geology of, 40.
Correlation of English Tertiary Beds with those of Continent, Dr. A. von Koenen, 410.
Corundum in Rhodesia, F. P. Mennell, 166.
Cotteswold Naturalists' Field Club, 479.
Crane, Walter, on Gold and Silver, 35.
Creechbarrow Limestone, Age of, Henry Keeping, 555.
Cretaceous Bryozoa, New Species of, J. W. Gregory, 61.
Cretaceous Plants, Structure and Affinities of, Marie C. Stopes, 557.
Crick, G. C., Cephalopods from Tyrol, 443.
Crinoid (*Tetracrinus* (?) *felix*, n.sp.) from Red Crag, F. A. Bather, 205.
Crook, T., Note on the Shore Sand, St. Ives Bay, Cornwall, 120; Optical Peculiarities in Phlogopite, 512.
Crustacea of the Carboniferous Rocks of Scotland, B. N. Peach, 76.

Crystal Drawing, Hints for, M. Reeks, 83.
Culm Inclusion in Coarse Granite, A. R. Hunt, 332.
Culm of Western Germany, Homotaxial Equivalents of the, Dr. W. Hind, 468.
Cyanide Processes, E. B. Wilson, 133.

DARTMOOR, Lodes of, Cassiterite and Specular Iron, Donald A. MacAlister, 402.
Darwin Centennial Commemoration, 375.
Davies, G. M., Note on the Shore Sand, St. Ives Bay, Cornwall, 120.
Davis, Professor W. M., Glacial Erosion of North Wales, 235.
Davison, C., Discussion at Geological Society, 89.
Dawkins, William Boyd, 529.
Deeley, R. M., 86; Scandinavian Ice-sheets and British Glacial Drifts, 239; Climate and Time, 287; Flow of Antarctic Ice, 370.
Derbyshire and Nottinghamshire, Lower Coal-measures, R. D. Vernon, 289.
Desert of Egypt, South-Western, W. F. Hume, 79.
Devon and Cornwall, Trilobite Fauna of, Ivor Thomas, Ph.D., 193.
Devonian Fishes of Iowa, Charles R. Eastman, 228.
Devonian Fossils from Cornwall, Ivor Thomas, Ph.D., 97.
Devonian Fossils from North Devon, J. G. Hamling, 133.
Dew-ponds, E. A. Martin, 96, 523.
Dewey, Henry, Overthrusts at Tintagel, North Cornwall, 283.
Diamond Matrices of Australia, J. Allan Thomson, 492.
Dibley, G. E., 88.
Dielasma, Loop of, D. M. S. Watson, 272.
Discoidea cylindrica, Jaw Apparatus of, H. L. Hawkins, 148.
Discussions at Geol. Soc., C. Davison, 89; B. Hobson, 190; O. Fisher, 239.
Dixon, E. E. L., Limestone Unconformities, etc., 514.
Dohrn, Felix Anton, 527.
Donegal, Calc-Silicate Limestones, Arthur E. V. Zealley, 554.
Douglas, J. A., Carboniferous Limestone, County Clare, 378.
Drabble, G. Cooper, Fluorspar Deposits of Derbyshire, 126.
Dry Chalk Valley Features, R. H. Chandler, 538.
Dumbartonshire, Geology and Petrology of the Kilsyth-Croy District, G. W. Tyrrell, 299, 359.
Dwerryhouse, A. R., Intrusive Rocks of Eskdale, Cumberland, 43.

EARTH-CREEP, E. H. L. Schwarz, 146.
Earth Tides, Professor Hecker, 323.
Earth's Interior, Convection Currents in, Rev. O. Fisher, 8.
Earthquake of Messina, 94; Californian, April 18, 1906, Andrew C. Lawson, 319; Benavente, Portugal, Vorticose Movements, B. Hobson, 383.
Eastman, C. R., Devonian Fishes of Iowa, 228.
Echinoids, Jurassic British, 40.
Egypt, Desert, Progress of Geological Survey, W. F. Hume, 79.
Egypt, Post-Glacial Time, Edward Greenly, 537; Cretaceous and Eocene Strata, W. F. Hume, 571.
Egyptian Oasis, its History, Geography, and Water Supply, H. J. Llewellyn Beadnell, 476; F. J. Bennett, 526.
Elles, Gertrude L., D.Sc., The Conway Succession, 136.
Eminent Living Geologists: J. J. Harris Teall, D.Sc., F.R.S., Director of the Geological Survey of Great Britain, 1; Ramsay Heatley Traquair, M.D., 241; William Boyd Dawkins, M.A., F.R.S., 529.
Erosive Action of Snowfall, G. W. Lamplugh, 523.
Erratic Boulders, South Pembrokeshire, R. H. Chandler, 220.
Evans, John W., Chrysolite, Chrysotile, and Karystiolite, 286.

FAUNA of the Chalk Rock, Contribution to the, C. P. Chatwin & T. H. Withers, 66.
Field Geologists, Handbook, C. W. Hayes, Ph.D., 424.
Finlayson, A. M., Nephrite and Magnesian Rocks, South Island, New Zealand, 285.
Fisher, Rev. Osmond, M.A., F.G.S., Convection Currents in the Earth's Interior, 8, 47; Discussion at Geological Society, 239; (November 17, 1817), 481.
Flint Surfaces, Pitting of, C. Carus-Wilson, 329.
Flints in Denmark, F. A. Bather, 47; in the Drift, T. Sheppard, 88.
Flow of Antarctic Ice, R. M. Deeley, 370.
Fluorspar Deposits of Derbyshire, C. B. Wedd & G. Cooper Drabble, 126.
Foraminifera, Prof. P. S. Pavlovic, 428.
Fossil Plants, Witteberg Series of Cape Colony, A. C. Seward, 482.
Fossil Representatives of the Lithodomous Worm *Polydora*, Dr. F. A. Bather, 108.
Fossils from the Nubian Sandstone Series of Egypt, R. Bullen Newton, 352, 388.

Fox-Strangways, C., Geology north and east of Harrogate, 423.

GALWAY, Igneous and Associated Rocks of, C. I. Gardiner, 516.
Gardiner, C. I., Igneous and Associated Rocks of Mayo, 85; of Galway, 516.
Gaudry, Professor Albert J., 48.
Genus *Loxonema*, with Description of New Proterozoic Species, Mrs. Jane Longstaff (*née* Donald), 135.
Geodes, Formation of, R. S. Bassler, 323.
Geological Conditions affecting the Coasts of England and Wales, W. Whitaker, 49, 113.
Geological Congress, International, Stockholm, 1910, 281.
Geological Cycles, Maritime Provinces of Canada, G. F. Matthew, D.Sc., 125.
Geological Features at China Clay Pit, Cornwall, J. H. Collins, 138.
Geological Hand-Map of British Isles, E. Stanford, 127.
Geological Maps of New York, Henry Leighton, 522.
Geological Society, Award of Medals, etc., 96.
Geological Society, Discussion at, 89, 190, 239.
Geological Society of Glasgow, History of, P. Macnair & F. Mort, 223.
Geological Society of London, 43, 44, 83, 134, 135, 136, 137, 138, 139, 230, 282, 283, 284, 325, 326, 327, 379; Annual General Meeting, 182.
Geological Survey, appointment, 96.
Geological Survey Memoirs: Geology of Small Isles of Inverness-shire, A. Harker, 423; Geology of Harrogate, C. Fox-Strangways, 423.
Geological Survey of Great Britain, Summary of Progress, 373.
Geological Survey of India, Report for 1907, by Sir T. H. Holland, 127.
Geologists' Association, Jubilee, 96; Geology in the Field, part i, 568.
Gibson, W., Geology of Country between Newark and Nottingham, 131.
Girty, G. H., Guadalupian Fauna, 562.
Glacial Erosion of North Wales, Professor W. M. Davis, 235.
Glacial Features at Aberedw, Wye Valley, L. Richardson, 490.
Glacial Lake Agassiz, Warren Upham, M.A., D.Sc., 475.
Glasgow, History of Geological Society of, P. Macnair & F. Mort, 223.
Glasgow Geological Society, Jubilee, 48.
Glauert, Ludwig, A New Species of *Sthenurus*, 380.
Gold, Geological Occurrence and Geographical Distribution of, J. Malcolm Maclaren, D.Sc., 226.
Gold and Silver, Walter Crane's Treatise on, 35.
Goldfields of British Guiana, Geology of, J. B. Harrison, 174.
Gordon, Mrs. M. M. Ogilvie, The Langkofl Thrust-mass, 488.
Gottsche, Carl, Ph.D., 575.
Grabham, G. W., Albitization of Basic Plagioclase Felspars, 250; Wells of the North-Eastern Soudan, 265, 311.
Grampian and Strathmore, Geology and Scenery of, Peter Macnair, 26.
Granites, Old, of Africa, C. B. Horwood and A. Wade, 455, 497, 543.
Graptolite-bearing Rocks of New Zealand, Douglass Isaacson, 74.
Greenly, Edward, Post-Glacial Time and Ancient Egypt, 537.
Gregory, J. W., New Species of Cretaceous Bryozoa, 61; What is a Mineral? 520.
Gresley, W. S., Coal Pebble in a Coal-seam, 157.
Guadalupian Fauna, G. H. Girty, 562.
Guppy, R. J. Lechmere, Geological Connexions of Caribean Region, 429.

HAMLING, J. G., Devonian Fossils, North Devon, 133.
Hamster Remains from the Norfolk Forest Bed, E. T. Newton, 110.
Harker, Alfred, Natural History of Igneous Rocks, 420; Geology of Small Isles of Inverness-shire, 423.
Harris, G. D., Rock Salt, its Origin, Geological Occurrence, etc., 279.
Harrison, J. B., Goldfields of British Guiana, 174.
Hartfell, Valentian Succession (North Cardiganshire), Owen T. Jones, 325.
Hastimima, Genus, from Brazil and the Cape, Henry Woodward, 486.
Hatch, F. H., Ph.D., Text-Book of Petrology, 176.
Hawkins, H. L., Jaw Apparatus of *Discoidea cylindrica*, 148.
Hayes, C. W., Ph.D., Handbook for Field Geologists, 424.
Hecker, Professor, Earth Tides, 323.
Henley-on-Thames, etc., Geology of, A. J. Jukes-Browne, 38.
Herries, R. S., 89.
Hill, J. B., & H. Kynaston, Geology of Country near Oban and Dalmally, 178.
Hill of Beath, Volcanic Neck in Fife, J. S. Grant Wilson & H. Brantwood Muff, 56.
Hind, Dr. W., Homotaxial Equivalents of Culm of Western Germany, 468.

Hobson, Bernard, Discussion at Geological Society, 190; Vorticose Movements in Earthquake of Benavente, Portugal, 383.
Holland, Sir T. H., K.C.I.E., Geological Survey of India, Report for 1907, 127.
Homotaxial Equivalents of Culm of Western Germany, Dr. W. Hind, 468.
Horwood, C. B., Old Granites of Transvaal and South and Central Africa, 455, 497, 543.
Howgill Fells and their Topography, J. E. Marr & W. G. Fearnsides, 380.
Hudleston, W. H., Obituary of, 143.
Human Intention, Dawn of, Professor A. Schwartz & Sir Hugh R. Beevor, 430.
Hume, Dr. W. F., Progress of Geological Survey of South-Western Desert of Egypt, 79; Changes in Level of Nile Valley, 479; Cretaceous and Eocene Strata of Egypt, 571; Granite Ridges of Kharga Oasis, 571.
Hunt, A. R., Culm Inclusion in Coarse Granite, 332; Old and New Theories of Igneous Rocks, 479.

IDDINGS, Joseph P., Igneous Rocks, vol. i, 559.
Igneous Rocks, vol. i, Joseph P. Iddings, 559.
Igneous Rocks, Classification according to Chemical Composition, Dr. H. Warth, 429.
Igneous Rocks, Constitution of, F. P. Mennell, 212.
Igneous Rocks, Natural History of, Alfred Harker, 420.
Igneous Rocks, Old and New Theories of, A. R. Hunt, 479.
Igneous Rocks of Singapore, J. B. Scrivenor, 17.
Igneous and Associated Rocks, co. Galway, C. I. Gardiner, 516.
Igneous and Associated Rocks, co. Mayo, C. I. Gardiner & S. H. Reynolds, 85.
India, Report of Geological Survey, 1907, Sir T. H. Holland, 127.
Intrusions of the Kilsyth–Croy District, Dumbartonshire, Geology, G. W. Tyrrell, 299, 359.
Intrusive Rocks, Eskdale, A. R. Dwerryhouse, 43.
Iowa, Devonian Fishes of, Charles R. Eastman, 228.
Isaacson, Douglass, Note on the Graptolite-bearing Rocks of New Zealand, 74.

JACKSON, J. Wilfrid, Type-specimen of *Pseudomelania rittata*, 542.
Jarosz, J., Stratigraphy of Carboniferous Limestone, Cracow, 375.
Jaw Apparatus of *Discoidea cylindrica* (Lamarck), H. L. Hawkins, 148.
Johnston, Mary S., A Jurassic Ganoid Fish, 309.
Johnston-Lavis, H. J., M.D., Eruption of Vesuvius in April, 1906, 281; Mechanism of Volcanic Action, 433.
Jones, Dr. F. Wood, Formation of Coral Reefs, 428.
Jones, Owen T., The Hartfell-Valentian Succession, North Cardiganshire, 325.
Jones, Professor T. Rupert, F.R.S., F.G.S. (October 1, 1819), 481.
Jukes-Browne, A. J., Depth and Succession of Bovey Deposits, 137, 257; Burning Cliff and Landslip at Lyme Regis, 228.
Jurassic Ammonite, New, J. F. Whiteaves, 524.
Jurassic Echinoids, 40.
Jurassic Ganoid Fish, *Pleuropholis lævissima*, Egerton, Mary S. Johnston, 309.
Jurassic Strata, South Dorset, S. S. Buckman, 570; Jurassic Ammonites and Brachiopods, 571.

KARROO System in Northern Rhodesia, A. J. C. Molyneux, 231.
Keeping, Henry, Age of Creechbarrow Limestone, 555.
Kendall, Rev. H. G. O., Palæolithic Implements, etc., from Wiltshire, 230.
Kharga Oasis, Granite Ridges, W. F. Hume, 571.
Kinahan, G. H., Obituary of, 142.
Korea, Journeys through, Dr. B. Kotô, 567.
Kotô, Dr., Journeys through Korea, 567.
Kynaston, H., Red Granite in the Transvaal, 229.
Kynaston, H., & J. B. Hill, Geology of Country near Oban and Dalmally, 178.

LABRADORITE-NORITE with Porphyritic Labradorite, Professor Johan H. L. Vogt, 134.
Lahat 'Pipe', Tin-ore Deposit in Perak, J. B. Scrivenor, 283.
Lamplugh, G. W., Geology of Country between Newark and Nottingham, 131.
Land and Sea, Battle of, by W. Ashton, 522.
Land Forms, Prof. W. M. Davis, 524.
Langkofl Thrust-mass, Mrs. M. M. Ogilvie Gordon, 488.
Laterite, Rhodesian, F. P. Mennell, 350.
'Laterite,' Use of term, T. Crook, 524.
'Laterite,' Use of word, J. B. Scrivenor, 431, 574.
Lawson, Andrew C., Californian Earthquake of April 18, 1906, 319.

Le Fort, P. de Loriol, Obituary of, 190.
Lennoxtown, Scotland, Boulder Distribution from, A. MacEwen Peach, 26.
Leonard, Hugh, Obituary of, 191.
Lepidophloios laricinus, Sternb., Anatomy of, D. M. S. Watson, 381.
Lesley, Peter and Susan, Life and Letters of, 517.
Lewis, F. J., Vegetation of British Peat Mosses, 324.
Lias, Middle and Upper, Sections near Batcombe, Somerset, L. Richardson, 540.
Limestone Pebbles in the Bunter Conglomerate, West Somerset, Source of, Edgar C. Martin, 160.
Limestone Unconformities, etc., E. E. L. Dixon, 514.
Limulus Woodwardi, sp. nov., from Lower Oolite, England, D. M. S. Watson, 14.
Lithodomous Worm, *Polydora*, Fossil Representatives of, Dr. F. A. Bather, 108.
Lomas, Joseph, 48.
Londonderry, Geology of, colour map, 523.
Longstaff, Mrs. Jane, Genus *Loxonema*, etc., 135, 329.
Loxonema, Phill., Genotype of, J. Longstaff, 135, 329.
Lyme Regis, Well-section and Fossils at Ware House, A. C. G. Cameron, 169.

MACALISTER, Donald A., Association of Cassiterite and Specular Iron in Lodes of Dartmoor, 402; The Geology of Ore Deposits, 565.
Maclaren, J. M., D.Sc., Gold, its Geological Occurrence and Geographical Distribution, 226.
Macnair, Peter, Geology and Scenery of the Grampians and Strathmore, 26.
Macnair, P., & F. Mort, History of Geological Society of Glasgow, 223.
Malay Peninsula, Obsidianites in, J. B. Scrivenor, 411.
Mandible of New Species of *Tetrabelodon* from Kansas, C. W. Andrews, D.Sc., 347.
Map, Geological, of British Isles, E. Stanford, 127.
Marlow, Chalk Section at the Waterworks Quarry, C. P. Chatwin & T. H. Withers, 123.
Marr, J. E., Palæolithic Implement found in Cambridgeshire Gravels, 534.
Marr, J. E., & W. G. Fearnsides, Howgill Fells and their Topography, 380.
Marsupials, Extinct, of Western Australia, B. H. Woodward, 210.
Martin, Edgar C., Source of Limestone Pebbles in the Bunter Conglomerate, West Somerset, 160.
Martin, Edward Alfred, Brighton Cliff Formation, 138; Dew-ponds, 96, 523.
Matthew, G. F., D.Sc., Geological Cycles in the Maritime Provinces of Canada, 125.
Maute, H. B., change of name from H. B. Muff, 576.
Mechanics of Overthrusts, T. Mellard Reade, 75; M. S. Smoluchowski, Ph.D., 204.
Mechanism of Volcanic Action, H. J. Johnston-Lavis, M.D., 433.
Mennell, F. P., Occurrence of Corundum in Rhodesia, 166; Constitution of Igneous Rocks, 212; Rhodesian Miners' Handbook, 323; Rhodesian Laterite, 350.
Merriam, J. C., Triassic Ichthyosauria, 36; Vertebrate Remains in Asphalt, 228.
Messina, Earthquake, 94.
Mexican Geology, Bibliography of, 173.
Micrasters from Franco-British Exhibition, 95.
Microsauria, Ancestors of the Reptilia, Roy L. Moodie, 216.
Mineral, What is a? J. W. Gregory, 520.
Mineral Discoveries, Northern Territory of S. Australia, H. Y. L. Brown, 323.
Mineralogical Society, 46, 139, 237, 377, 572.
Mines, Royal School of, Annual Dinner, 229.
Mining Journal, Seventy-fifth Anniversary, 521.
Moberg, J. C., Nomenclature of Palæozoic Formation of Sweden, 273.
Mollusca, Fossil, showing Colour-Markings, 43.
Molyneux, A. J. C., The Karroo System in Northern Rhodesia, 231.
Moodie, Roy L., Microsauria, Ancestors of the Reptilia, 216.
Moray, The 'Trias' of, D. M. S. Watson, 102.
Morgan, Edward Delmar, 432.
Morgan, P. G., Geology of Mikonui, New Zealand, 478.
Mort, Frederick, 48.
Muff, H. Brantwood, Hill of Beath, 56; change of name to Maute, 576.
Museum, Cardiff, New Director, 95.
Museum of Practical Geology, Jermyn Street, Guide to Museum, 431.
Mutual Interference of Artesian Wells, H. J. L. Beadnell, 23.
Myotragus Balearicus, gen. et sp. nov., New Artiodactyle, from Majorca, Dorothea M. A. Bate, 385.

NATURAL Monuments, Care of, Professor H. Conwentz, 429.
Nephrite and Magnesian Rocks, New Zealand, A. M. Finlayson, 285.
New Hebrides, Foraminifera from, 42.
New Zealand, Geological Survey of Mikonui, P. G. Morgan, 478.
Newark and Nottingham, Geology of Country between, G. W. Lamplugh, W. Gibson, D.Sc., R. L. Sherlock, and W. B. Wright, 131.
Newton, E. T., Hamster Remains from the Norfolk Forest Bed, 110.
Newton, R. Bullen, Fossils from Nubian Sandstone Series of Egypt, 352, 388.
Nile Valley, Changes in Level of, Dr. W. F. Hume, 479.
Nodules, Plant containing, from Japan, Marie C. Stopes, D.Sc., 233, 557.
Norfolk Forest Bed, Hamster Remains from, E. T. Newton, 110.
Nubian Sandstone Fossils, Egypt, R. Bullen Newton, 352, 388.

OBAN and Dalmally, Geology of Country near, H. Kynaston & J. B. Hill, 178.
Obituary: Professor Albert J. Gaudry (1827–1908), 48; Joseph Lomas (1860–1908), 48, 90; J. S. Grant Wilson (1855–1908), 91; Sir Thomas Wardle (1831–1909), 92; H. M. Bernard (1853–1909), 92; Professor H. G. Seeley (1839–1909), 93; Lady Warington Smyth, 96; George Henry Kinahan, M.R.I.A. (1829–1908), 142; W. H. Hudleston (1828–1909), 143; Perceval de Loriol le Fort (1828–1908), 190; Hugh Leonard (1841–1909), 191; James Parsons, B.Sc. (1876–1908), 192; F. G. Hilton Price (1842–1909), 239; Thomas Mellard Reade (1832–1909), 333; Edward Delmar Morgan (1840–1909), 432; Joseph Frederick Whiteaves (1835–1909), 432; William Ford Stanley (1828–1909), 480; Dr. Felix Anton Dohrn (1840–1909), 527; Carl Gottsche (1855–1909), 575; Thomas Roxburgh Polwhele (1831–1909), 576.
Obsidianites in Malay Peninsula, J. B. Scrivenor, 411.
Old Granites of Transvaal and South and Central Africa, C. B. Horwood, 455, 497, 543.
Oldham, R. F., The Californian Earthquake, 45.
Oolite of Lansdown, Bath, Well-sinking in, Rev. H. H. Winwood, 119.
Oolite, Lower, *Limulus Woodwardi*, sp. nov., from, D. M. S. Watson, 14.
Optical Peculiarities in Phlogopite, T. Crook, 512.
Orange Grove Granite, Petrographical Description of, A. Wade, 549.
Ore Deposits, Geology of, H. H. Thomas and D. A. MacAlister, 565.
Otago, Western, New Zealand, Geology of, James Park, 322.
Ottawa, Department of Mines, Report of Geological Survey Branch, 429.
Overthrusts, Mechanics of, T. Mellard Reade, 75; M. S. Smoluchowski, Ph.D., 204.
Overthrusts at Tintagel (North Cornwall), Henry Dewey, 283.

PALÆOLITHIC Implement in Cambridgeshire Gravels, J. E. Marr, 534.
Palæolithic Implements, etc., from Wiltshire, Rev. H. G. O. Kendall, 230.
Palæontographical Society, 236.
Palæozoic Formations of Sweden, Nomenclature of, J. C. Moberg, 273.
Palæozoic Strata of Charkow, Russia, N. Yakowlew, 78.
Park, James, Geology of Cromwell, Western Otago, New Zealand, 322.
Parsons, James, Obituary of, 192.
"Passer Vennensis," 89.
Past Presidents of Geological Society, R. S. Herries, 89.
Pavlovic, Professor P. S., New Foraminifera, 428.
Peach, A. MacEwen, Boulder Distribution from Lennoxtown, Scotland, 26.
Peach, B. N., Monograph on the Higher Crustacea of the Carboniferous Rocks of Scotland, 76.
Pearl from the Chalk, G. E. Dibley, 88.
Pearls, Fossil Cretaceous, 42.
Pembrokeshire, South, Erratic Boulders in, R. H. Chandler, 220.
Permian Footprints, G. Hickling, 523.
Permian in North-East of England, David Woolacott, 513.
Petrographical Description of Orange Grove Granite, A. Wade, 549.
Petrography of New Red Sandstone, West of England, H. H. Thomas, 234.
Petrology, Text-Book of, F. H. Hatch, Ph.D., 176.
Phacops (*Trimerocephalus*) *lævis* (Münst.), Ivor Thomas, Ph.D., 167.
Phacops Weaveri, Salter, F. R. Cowper Reed, 69.
Philippine Islands, Geology of, Warren D. Smith, 430.
Phlogopite, Optical Peculiarities in, T. Crook, 512.
Plagioclase Felspars, Albitization of, E. B. Bailey & G. W. Grabham, 250.

Plants, Cretaceous, Structure and Affinities of, Marie C. Stopes, 557.
Pleistocene Canidæ, British, Professor S. H. Reynolds, 569.
Pleurophalis lævissima, Egerton, Jurassic Ganoid Fish, Mary S. Johnston, 309.
Polwhele, Thomas Roxburgh, 576.
Polyzoa, Chalk, New or imperfectly known, R. M. Brydone, 337, 398.
Post-Glacial Condition of British Isles, etc., R. M. Deeley, 86.
Post-Glacial Time and Ancient Egypt, Edward Greenly, 537.
Pre-Glacial Rock-Platform, Wexford Coast, F. R. Cowper Reed, 507.
Price, F. G. Hilton, Obituary of, 239.
Pseudomelania vittata (Phillips), Type-specimen, T. Wilfrid Jackson, 542.
Pseudomorphs of Salt-crystals, Keuper Marl, 45.

QUEENSLAND Geological Survey, 'Etheridge Goldfield,' 523.

RASTALL, R. Heron, Boulders of the Cambridge Drift, 284.
Reade, Thomas Mellard, Mechanics of Overthrusts, 75; Obituary, 333.
Red Granite of the Transvaal, H. Kynaston, 229.
Reed, F. R. Cowper, *Phacops Weaveri*, Salter, 69; Pre-Glacial Rock-Platform, Wexford Coast, 507.
Reeks, Margaret, Crystal Drawing, 83.
Reptilia, Microsauria, Ancestors of the, Roy L. Moodie, 216.
Reptilian Remains from Trias, Lossiemouth, D. M. S. Watson, 380.
Reptilian Tracks, Trias of Runcorn, Cheshire, D. M. S. Watson, 381.
Reynolds, S. H., Igneous and Associated Rocks, Co. Mayo, 85; British Pleistocene Canidæ, 569.
Rhætic Section at Wigston, Leicestershire, L. Richardson, 366.
Rhodesia, Occurrence of Corundum in, F. P. Mennell, 166; Museum, Seventh Annual Report, 428.
Rhodesian Laterite, F. P. Mennell, 350.
Rhodesian Miners' Handbook, F. P. Mennell, 323.
Richardson, L., Rhætic Section at Wigston, Leicestershire, 366; Glacial Features at Aberedw in the Wye Valley, 490; River Development in Mid-South Wales, 508; Middle and Upper Lias Sections near Batcombe, Somerset, 540.
River Development in Mid-South Wales, L. Richardson, 508.
Rock Salt, Origin, Geological Occurrence, etc., G. D. Harris, C. J. Maury, & L. Reinecke, 279.
Rocks near Heathcote, Victoria, Origin, etc., E. W. Skeats, 84.
Rocks of New Zealand bearing Graptolites, Douglass Isaacson, 74.
Rogers, A. W., 46; Introduction to Geology of Cape Colony, 561.
Romanes, J., Boulders of the Cambridge Drift, 284.
Royal Society, 382, 384, 557; election of Sir A. Geikie as President, 95.

ST. IVES Bay, Cornwall, Note on Shore Sand, T. Crook & G. M. Davies, 120.
Scandinavian Ice-sheets and British Glacial Drifts, T. G. Bonney, 188; R. M. Deeley, 239.
Schwartz, Professor A., The Dawn of Human Intention, 430.
Schwarz, Professor E. H. L., Secular Earth-Creep, 145.
Scrivenor, J. B., Igneous Rocks of Singapore, 17; The Lahat 'Pipe', Tin-ore Deposits in Perak, 283; Archæan or Lower Palæozoic Rocks, Malay Peninsula, 330; Obsidianites in Malay Peninsula, 411; Use of the word 'Laterite', 431, 574.
Seaford (Sussex), Geology of, J. Vincent Elsden, 326.
Secular Earth-Creep, Prof. Schwarz, 146.
Seeley, Professor H. G., 93.
Seward, A. C., Fossil Plants from Witteberg Series of Cape Colony, 182.
Sheppard, T., 88.
Shore Sand, St. Ives Bay, Cornwall, T. Crook & G. M. Davies, 120.
Silurian Bivalves of Victoria, 42.
Singapore, Igneous Rocks of, J. B. Scrivenor, 17.
Skeats, E. W., Origin, etc., of Rocks near Heathcote, Victoria, 84.
Skull of *Tapinocephalus*, Professor R. Broom, 400.
Smith, Rev. Frederick, Stone Ages in North Britain and Ireland, 321.
Smith, Geoffrey, Living and Fossil Anaspidacea, 425.
Smith, W. Campbell, Composition of 'Borolanite' from Am Mealla, Rossshire, 152.
Smith, Warren D., Geology of Philippine Islands, 430.
Smoluchowski, M. S., Ph.D., Mechanics of Overthrusts, 204.
Smyth, Lady Warington, 96.
South Africa, Fossils from, 41.
Spirorbis-Limestones in 'Permian' of South Staffordshire and Warwickshire Coal-fields, T. C. Cantrill, 447.

Stanley, William Ford, 480.
Sthenurus, A New Species, Ludwig Glauert, 380.
Stomach-Stones of Reptiles, occurring fossil, 43.
Stone Ages, North Britain and Ireland, Rev. F. Smith, 321.
Stopes, Marie C., Cretaceous Plants, 557.
Strathmore and the Grampians, Geology and Scenery of, Peter Macnair, 26.
Stratigraphy of Carboniferous Limestone, Cracow, J. Jarosz, 375.
Sudan, North-Eastern, Wells of, G. W. Grabham, 265, 311.

TAPINOCEPHALUS, Skull of, Professor R. Broom, 400.
Tarntal Mass, Structure and Physiography of, Alfred P. Young, Ph. D., 339.
Teall, J. J. Harris, D.Sc., F.R.S., 1.
Tertiary Beds, Correlation of English with those of the Continent, Dr. A. von Koenen, 410.
Tetrabelodon, Mandible of a New Species of, from Kansas, C. W. Andrews, D.Sc., 347.
Tetracerinus (?) *felix*, n.sp., from the Red Crag, F. A. Bather, D.Sc., 205.
Thomas, H. H., Petrography of New Red Sandstone, West of England, 234; Geology of Ore Deposits, 565.
Thomas, Ivor, Ph.D., New Devonian Fossils from Cornwall, 97; Note on *Phacops lewisi*, 167; Trilobite Fauna of Devon and Cornwall, 193.
Thomson, J. Allan, Diamond Matrices of Australia, 492.
Thrust- and Crush-brecciation, Magnesian Limestone, Durham, Dr. D. Woolacott, 323.
Thrust-mass, The Langkofl, Mrs. M. M. Ogilvie Gordon, 488.
Tin, Origin of, in Malay Peninsula, J. B. Scrivenor, 524.
Tin-mining and Water-supply, Malay States, J. B. Scrivenor, 524.
Transvaal and South and Central Africa, Old Granites of, C. B. Horwood, 455, 497, 543.
Traquair, R. H., M.D., F.R.S., 241.
Trias in the Caucasus, Discovery of, by W. T. Worobiev, translated by Felix Oswald, D.Sc., 171.
'Trias' of Moray, D. M. S. Watson, 102.
Triassic Ichthyosauria, J. C. Merriam, 36.
Triassic Plant, *Yuccites vogesiacus*, Affinities of, E. A. Newell Arber, 11.
Trilobite and Lamellibranch from Cornwall, Ivor Thomas, Ph.D., 97.
Trilobite Fauna of Devon and Cornwall, Ivor Thomas, Ph.D., 193.
Trimingham Chalk, South Bluff, R. M. Brydone, 189.
Tsetse Fly in the Miocene, T. D. A. Cockerell, 228.
Tygerberg Anticline, Cape Colony, 46.
Tyrol, Cephalopods, G. C. Crick, 443.
Tyrrell, G. W., Geology and Petrology of the Intrusions of Kilsyth–Croy District, Dumbartonshire, 299, 359.

UNCONFORMITIES, etc., Limestone, E. E. L. Dixon, 514.
Upham, Warren, M.A., D.Sc., Glacial Lake Agassiz, 475.
Ussher, W. A. E., Retirement of, 576.

VALLEY Formation, Solution Theory of, C. N. Bromhead, 142.
Vegetation of British Peat Mosses, F. J. Lewis, 324.
Vernon, R. Douglass, Lower Coal-measures, Derbyshire and Notts, 289.
Vertebrate Remains in Asphalt, J. C. Merriam, 228.
Vesuvius, Eruption in April, 1906, H. J. Johnston-Lavis, M.D., 433.
Victoria Falls, Rhodesia, Neighbourhood of the, T. Codrington, 233.
Vogt, Professor Johan H. L., Labradorite-Norite, 134.
Volcanic Action, Mechanism of, H. J. Johnston-Lavis, M.D., 433.
Volcanic Neck in Fife, J. S. Grant Wilson & H. Brantwood Muff (Maufe), 56.
Von Koenen, Dr. A., Correlation of English and Continental Tertiary Beds, 410.

WADE, A., Petrographical Description of Orange Grove Granite, 549.
Wales, Mid-South, River Development in, L. Richardson, 508.
Wardle, Sir Thomas, 92.
Warth, Dr. H., Classification of Igneous Rocks according to Chemical Composition, 429.
Water Supply of Bedfordshire and Northamptonshire from underground sources, H. B. Woodward, 180; of Kent, with Records of Sinkings and Borings, W. Whitaker, 180.
Watson, D. M. S., *Limulus Woodwardi*, sp. nov., from Lower Oolite of England, 14; The 'Trias' of Moray, 102; The Loop of *Dielasma*, 272; Reptilian Remains from Trias, Lossiemouth, 380; Reptilian Tracks from the Trias of Runcorn, Cheshire, 381; Anatomy of *Lepidophloios laricinus*, Sternb., 381.

Wedd, C. B., Fluorspar Deposits of Derbyshire, 126.
Wells of the North-Eastern Sudan, G. W. Grabham, 265, 311.
Well-section and Fossils at Ware House, near Lyme Regis, A. C. G. Cameron, 169.
Well-sinking in Great Oolite of Lansdown, Bath, Rev. H. H. Winwood, 119.
Western Australia, Geological Survey Report, Harry P. Woodward, 430.
Wexford Coast, Pre-Glacial Rock-Platform of, F. R. Cowper Reed, 507.
Whitaker, W., Geological Conditions affecting the Coasts of England and Wales, 49, 113; Water Supply of Kent, 180.
Whiteaves, Joseph Frederick, 432.
Wigston, Leicestershire, Rhætic Section at, L. Richardson, 366.
Wilson, E. B., Cyanide Processes, 133.
Wilson, J. S. Grant, Hill of Beath, 56, 91.
Winnipeg, British Association Meeting, Presidential Address, 413; List of Papers read in Section C, etc., 473.
Winwood, Rev. H. H., Well-sinking in the Great Oolite of Lansdown, Bath, 119.
Withers, T. H., Chalk Section at the Waterworks Quarry, Marlow, 123; Contribution to the Fauna of the Chalk Rock, 66.
Woodward, A. Smith, LL.D., Address to Geological Section, British Association, Winnipeg, 413.
Woodward, B. H., Extinct Marsupials of Western Australia, 210.
Woodward, Harry P., Report of Geological Survey, Western Australia, 430.
Woodward, Henry, Genus *Hastimima* from Brazil and the Cape, 486.
Woodward, H. B., Water Supply of Bedfordshire and Northamptonshire, 180.
Woolacott, David, Permian in North-East of England, 513; Thrust- and Crush-brecciation, Magnesian Limestone, Durham, 323.
Worobiev, W. J., Discovery of Trias in the Caucasus, 171.
Wye Valley, Glacial Features at Aberedw, L. Richardson, 490.

YAKOWLEW, N., Palæozoic Strata of Charkow, Russia, 78; The Attachment of Brachiopods as Basis of Genera and Species, 426.
Young, Alfred P., Ph.D., Structure and Physiography of the Tarntal Mass, 339.

ZEALLEY, Arthur E. V., Calc-Silicate Limestones, Donegal, 554.
Zoological Society, Reports and Proceedings, 573.

STEPHEN AUSTIN AND SONS, LTD., PRINTERS, HERTFORD.

No. 546. Decade V.—Vol. VI.—No. XII. Price 1s. 6d. net.

THE GEOLOGICAL MAGAZINE

OR

Monthly Journal of Geology.

WITH WHICH IS INCORPORATED

THE GEOLOGIST.

LIBRARY OF THE UNIVERSITY OF WISCONSIN

EDITED BY

HENRY WOODWARD, LL.D., F.R.S., F.G.S., &c.

ASSISTED BY

PROFESSOR J. W. GREGORY, D.Sc., F.R.S., F.G.S.,
DR. GEORGE J. HINDE, F.R.S., F.G.S.,
SIR THOMAS H. HOLLAND, K.C.I.E., A.R.C.S., D.Sc., F.R.S., F.G.S.,
PROFESSOR W. W. WATTS, Sc.D., M.Sc., F.R.S., V.P. G.S.,
DR. ARTHUR SMITH WOODWARD, F.R.S., F.L.S., SEC. GEOL. SOC., AND
HORACE B. WOODWARD, F.R.S., F.G.S.

DECEMBER, 1909.

CONTENTS.

I. ORIGINAL ARTICLES. *Page*

Eminent Living Geologists: Professor W. BOYD DAWKINS, M.A., D.Sc., F.R.S., F.S.A., F.G.S. (With a Portrait, Plate XXX.) 529

On a Palæolithic Implement found *in situ* near Hildersham, Cambridgeshire. By J. E. MARR, Sc.D., F.R.S. (Plate XXXI.) 534

Post-Glacial Time and Ancient Egypt. By EDWARD GREENLY, F.G.S. ... 537

Dry Chalk Valley Features. By R. H. CHANDLER 538

Sections in Middle and Upper Lias, Somerset. By L. RICHARDSON, F.R.S.E., F.G.S. 540

The Type-specimen of *Pseudomelania vittata*. By J. W. JACKSON, F.G.S., Manchester Museum 542

The Old Granites of Africa. By C. B. HORWOOD, F.G.S., and A. WADE, F.G.S. (Concluded from the November number.) (Plate XXVII.) 543

Calc-Silicate Limestone, Donegal. By A. E. V. ZEALLEY, A.R.C.S., Rhodesia Museum 554

Age of Creechbarrow Limestone. By HENRY KEEPING 555

II. NOTICES OF MEMOIRS. *Page*

Faunal Horizons in Bristol Coal-field. By Herbert Bolton, F.R.S.E., F.G.S. 557

Studies of Cretaceous Plants. By M. C. Stopes, Ph.D., and K. Fujii, Ph.D. 557

III. REVIEWS.

J. P. Iddings' Igneous Rocks 559

Dr. A. W. Rogers' & A. L. Du Toit's Geology of Cape Colony 561

G. H. Girty's Guadalupian Fauna ... 562

Thomas & MacAlister's Ore Deposits 565

Dr. B. Kotô's Journeys in Korea ... 567

The Geologists' Association 568

Brief Notices: Pleistocene Canidæ—Norfolk and Norwich Naturalists' Society—Plesiosaurs—Index for London Library 569

IV. REPORTS AND PROCEEDINGS.

Geological Society of London, Nov. 3 570

Mineralogical Society 572

Zoological Society 573

V. CORRESPONDENCE.

Mr. J. B. Scrivenor, B.A., F.G.S. 574

VI. OBITUARY.

Dr. Carl Gottsche 575

T. R. Polwhele, J.P., D.L., M.A., F.G.S. 576

VII. MISCELLANEOUS.

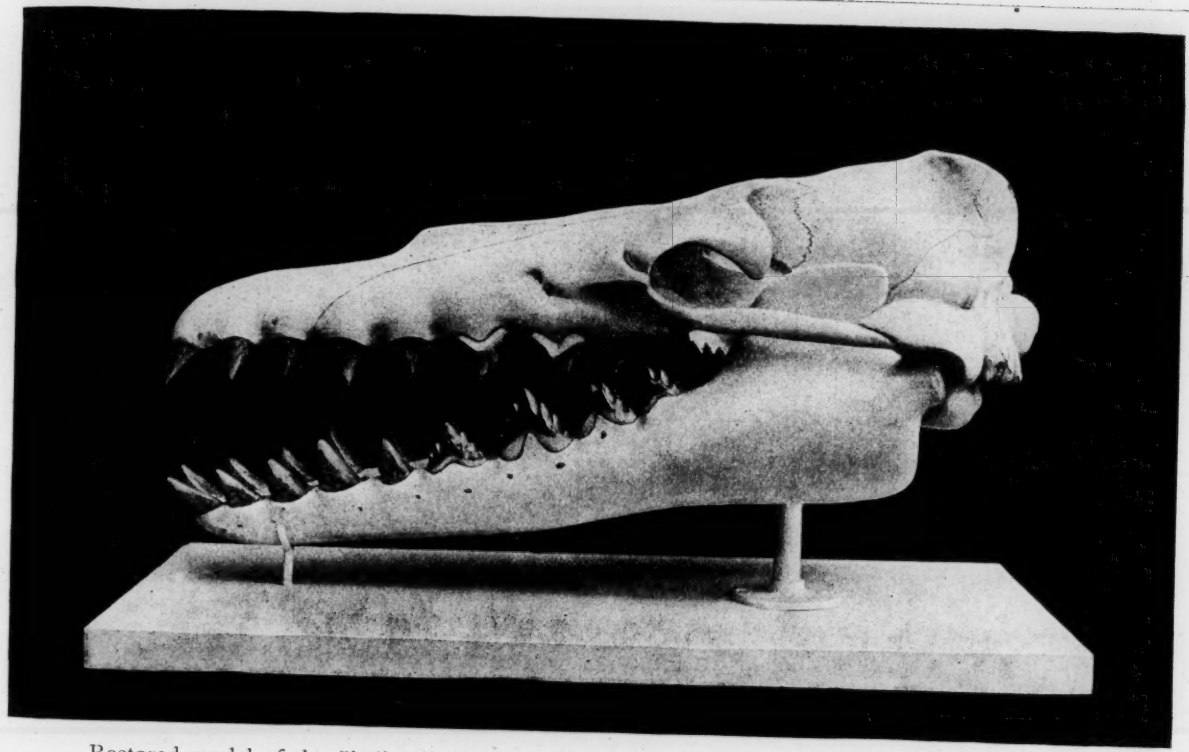
Retirement of Mr. W. A. E. Ussher, F.G.S. 576

Change of Name 576

With this Number is presented an Extra Sheet, containing Index and Title for Decade V, Vol. VI, 1909.

LONDON: DULAU & CO., LTD., 37, SOHO SQUARE, W.

☞ The Volume for 1909 of the GEOLOGICAL MAGAZINE is ready,



Restored model of the Skull and Mandible of *Prozeuglodon atrox*, Andrews. About $\frac{1}{6}$ nat. size.
Middle Eocene: Fayûm, Egypt. As supplied by

ROBERT F. DAMON, Weymouth, England.

LIST OF NATURAL HISTORY AND SCIENTIFIC BOOKS AND PAPERS ON SALE BY

DULAU & CO., LTD., 37, SOHO SQUARE, LONDON, W.

AUSTEN (E. E.). Illustrations of African Blood-sucking Flies, other than Mosquitoes and Tsetse Flies. With coloured figures by GRACE EDWARDS. Roy. 8vo. pp. 236. 27*s.* 6*d.*

BALL (SIR ROBERT S.). The Earth's Beginning. New edition. 8vo, 8¼ by 5½. pp. 400. 7*s.* 6*d.*

BOULENGER (GEORGE A.). Catalogue of the Fresh-water Fishes of Africa in the British Museum (Natural History). Vol. i. pp. 384, 270 text-figures. Imp. 8vo. 32*s.* 6*d.*

BULLER (A. H. REGINALD). Researches on Fungi. An Account of the Production, Liberation, and Dispersion of the Spores of Hymenomycetes treated Botanically and Physically. 8vo, 9¾ by 6½. pp. 300. 12*s.* 6*d.* net.

BUTLER (G. M.). A Pocket Handbook of Minerals. 1908. Illustrated. 12*s.* 6*d.* net.

CHATLEY (HERBERT). Stresses in Masonry. 1909. Crown 8vo, 7½ by 4¾. pp. 154. 3*s.* 6*d.* net.

ELLIS (DAVID). Outlines of Bacteriology; Technical and Agricultural. 1909. 8vo, 8¾ by 5½. pp. 274. 7*s.* 6*d.* net.

FOWLER (A.). The Spectrum of Magnesium Hydride. 1909. 4to. Two plates. 2*s.* 6*d.*

FURNEAUX (W. S.). Field and Woodland Plants. 1909. Crown 8vo. Cloth. 6*s.* net.

GEOLOGICAL MAGAZINE (THE). The Forty Years' Index, 1864–1903. Compiled by ELLEN S. WOODWARD. Edited by HENRY WOODWARD, LL.D., F.R.S. 1905. 8vo. Cloth. £1 1*s.* net.

GREGORY (J. W.). Catalogue of the Cretaceous Bryozoa. Vol. ii, with 75 woodcuts and 9 plates. 1909. 8vo. Cloth. 13*s.*

HARRISON (J. B.). The Geology of the Goldfields of British Guiana, with Historical, Geographical, and other chapters by F. FOWLER and C. W. ANDERSON, and with an Appendix giving the Laws and Regulations governing the Mining Industry. 1908. 8vo. Cloth. Illustrated. 5*s.* net.

HATCH (F. H.). Text-Book of Petrology. Fifth edition. Revised and rewritten. 1909. 8vo. Cloth. 7*s.* 6*d.* net.

HOUGHTON (C. E.). The Elements of Mechanics of Materials. A Text-book for Students in Engineering Courses. 1909. 8vo, 8¾ by 5½. pp. 194. 7*s.* 6*d.* net.

HOULLEVIGUE (L.). The Evolution of the Sciences. 8vo, 8½ by 5½. pp. 320. 6*s.* 6*d.* net.

HOUSTON (E. J.). Volcanoes and Earthquakes. 1908. Crown 8vo. With 61 illustrations. Cloth. 3*s.* 6*d.*

IDDINGS (J. P.). Igneous Rocks. Vol. i. 1909. 8vo. £1 1*s.* net.

ISLE OF WIGHT. A Guide to the Natural History. This work contains contributions on the Geology, Earthquakes, Stone Implements, and Meteorology. 1909. Demy 8vo. Cloth. 8*s.* 6*d.* net.

JOHNSON (J. P.). The Ore Deposits of South Africa, with a chapter on Hints to Prospectors. Pt. i: Base Metals. 1909. 8vo. Cloth. 5*s.* net.

——— Part ii: The Witwatersrand and Pilgrimerest Goldfields and similar Occurrences. 1909. 8vo, 8¾ by 5½. pp. 60. 5*s.* net.

——— Stone Implements of South Africa. 1907. 8vo. Illustrated. 7*s.* 6*d.*

KIRKALDY (J. W.) & DRUMMOND (I. M.). An Introduction to the Study of Biology. 1909. Crown 8vo, 7¾ by 5. pp. 266. 6*s.* 6*d.*

KOESTER (FRANK). Hydro-electric Developments and Engineering. 1909. Illustrated. Imp. 8vo, 10½ by 7¼. pp. 480. 21*s.* net.

LOGAN (J. A.). Practical Mining in South Africa. 1908. 8vo. Cloth. 10*s.* 6*d.*

LOUIS (H.). The Dressing of Minerals. With 410 illustrations. 1909. Super-royal 8vo. Cloth. £1 10*s.*

LOW (D. A.). Applied Mechanics; embracing Strength and Elasticity of Materials, etc. 1909. 8vo. Cloth. 7*s.* 6*d.* net.

MACLAREN (J. M.). Gold: its Geological Occurrence and Geographical Distribution. 1908. 8vo. Cloth. Coloured plate and 278 illustrations. £1 5*s.* net.

MAYER (LUCIUS W.). Mining Methods in Europe. With 92 illustrations. 1909. Crown 8vo. Cloth. 10*s.* 6*d.* net.

MEADE (R. K.). Portland Cement: its Composition, etc. New edition. 8vo. 14*s.* 6*d.* net.

MOOR (C. G.). The Recognition of Minerals. With Monographs on Geology, Ore Deposits, etc., by DONALD A. MACALISTER. 1909. 8vo. 7*s.* 6*d.* net.

OWENS (J. S.) & CASE (G. O.). Coast Erosion and Foreshore Protection. London, 1908. 8vo. Illustrated. Cloth. 7*s.* 6*d.* net.

PHILIP (JAMES C.). The Romance of Modern Chemistry. 1909. Illustrated. Crown 8vo, 8 by 5. pp. 348. 5*s.*

RENSHAW (GRAHAM). Animal Romances. Illustrated. Royal 8vo, 10 by 7. pp. 220. 7*s.* 6*d.* net.

RICHARDS (ROBERT H.). Ore Dressing. 4 vols. 8vo. Cloth. £4 4*s.* net. Vols. iii and iv just issued, price per vol. £1 1*s.*, will be supplied to subscribers possessing i and ii.

ROBERTS (R. D.). An Introduction to Modern Geology. 8vo. With coloured maps and illustrations. Cloth. 4*s.* 6*d.*

SHARPE (R. B.). Hand-list of Birds. Vol. v. 1909. 8vo. pp. 698. (Vols. i–iv 10*s.* each.) £1

SHEPPARD (T.). Geological Rambles in East Yorkshire. London. 8vo. Cloth. With map and illustrations. 7*s.* 6*d.* net.

SMITH (F.). The Stone Ages in North Britain and Ireland. With an Introduction by A. H. KEANE, LL.D., F.R.G.S. 1909. 8vo. Cloth. Illustrated. 16*s.* net.

STIGAND (C. H.). The Game of British East Africa. 1909. Illustrated. 4to, 11¼ by 8½. pp. 322. £1 1*s.* net.

STORMS (W. H.). Timbering and Mining, Practical Methods based on American Practice. 1909. pp. 300. 8vo. Cloth. Fully illustrated. 8*s.* 6*d.* net.

STUART-MENTEATH (P. W.), A.R.S.M. Pyrenean Geology. 1903–7. pp. 169. 8vo. Sewed. 3*s.* 6*d.* net.

——— La nueva Geologia en los Pirineos de Aragon. 1909. 8vo. pp. 7. 6*d.*

THOMAS (H. H.) & MACALISTER (D. A.). The Geology of Ore Deposits. 1909. Crown 8vo. Illustrated. 7*s.* 6*d.* net.

WANG (CHUNG YU). Antimony: its History, Chemistry, Mineralogy, Geology, Uses, etc. London, 1909. 8vo. Illustrated. 12*s.* 6*d.* net.

WHEELER (J. T.). The Zonal-Belt Hypothesis. 1909. 8vo. Cloth. 10*s.* 6*d.*

WHITAKER (W.). The Water Supply of Kent, with records of Sinkings and Borings; with contributions by H. FRANKLIN PARSONS, H. R. MILLS, and J. C. THRESH. 1909. Roy. 8vo. Cloth. 8*s.* 6*d.*

WRIGHT (WILLIAM H.). The Grizzly Bear. The Narrative of a Hunter-Naturalist, Historical, Scientific, and Adventurous. 1909. 8vo, 8½ by 5¾. pp. 284. Illustrated. 7*s.* 6*d.* net.

All communications for this Magazine should be addressed—

TO THE EDITOR,

13, Arundel Gardens, Notting Hill, London, W.

Books and Specimens to be addressed to the Editor as usual, care of

MESSRS. DULAU & CO., LTD., 37, SOHO SQUARE, W.

STEPHEN AUSTIN AND SONS, LTD., PRINTERS, HERTFORD.